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VOLUME III
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Rocky Mountain Arsenal
Information Center
Commerce City, Colorado

Biota Remedial Investigation

Final Report
(Version 3.2)
Volume III

May 1989
Contract Number DAAK11-84-D0016
Task Number 9

Environmental Science And Engineering, Inc.

Rocky Mountain Arsenal
Information Center
Commerce City, Colorado

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1. AGENCY USE ONLY (Leave blank)		2. REPORT DATE 05/00/89	3. REPORT TYPE AND DATES COVERED	
4. TITLE AND SUBTITLE BIOTA REMEDIAL INVESTIGATION, TASK 9, FINAL REPORT, VERSION 3.2 13			5. FUNDING NUMBERS DAAK11 84 D 0016	
6. AUTHOR(S)				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) ENVIRONMENTAL SCIENCE AND ENGINEERING			8. PERFORMING ORGANIZATION REPORT NUMBER 89173R02	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) ROCKY MOUNTAIN ARSENAL (CO.). PMRMA			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES				
12a. DISTRIBUTION/AVAILABILITY STATEMENT APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) THE PURPOSE OF THE BIOTA REMEDIAL INVESTIGATION REPORT IS TO PRESENT THE CURRENT NATURE AND EXTENT OF CONTAMINATION IN BIOTA ON RMA. THE REPORT INTEGRATES KNOWN HISTORICAL INFORMATION, THE RESULTS OF PREVIOUS INVESTIGATIONS, AND RESULTS OF CURRENT PROGRAMS. THE REPORT IS DIVIDED INTO THE FOLLOWING SECTIONS: 1. GENERAL BACKGROUND INFORMATION ON RMA CONTAMINATION AND PAST INVESTIGATIONS 2. DESCRIPTION OF THE PHYSICAL ENVIRONMENT, REGIONAL BIOTA, AND BIOTA WITHIN THE ARSENAL; IDENTIFICATION OF IMPORTANT BIOLOGICAL COMPONENTS AS A BASIS FOR EVALUATING CONTAMINATION 3. SUMMARY OF THE METHODS USED IN THIS ASSESSMENT 4. DATA ON THE TYPES AND CONCENTRATIONS OF CONTAMINANTS IN RMA BIOTA 5. ASSESSMENT OF THE DISTRIBUTION AND CONCENTRATION OF CONTAMINANTS IN BIOTA AND ASSOCIATED ENVIRONMENT TO EVALUATE PATHWAYS FOR CONTAMINANT MOVEMENT				
14. SUBJECT TERMS TOXICOLOGY, FAUNA, FLORA			15. NUMBER OF PAGES	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT	

89173R02
VOLUME III
ORIGINAL

LITIGATION TECHNICAL SUPPORT AND SERVICES

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Rocky Mountain Arsenal



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Information Center
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Biological Investigation

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Contract Number DAAK11-84-D0016
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Prepared by
ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

Prepared for
OFFICE OF THE PROGRAM MANAGER
ROCKY MOUNTAIN ARSENAL CONTAMINATION CLEANUP

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TABLE OF CONTENTS

Section	Page
VOLUME I	
EXECUTIVE SUMMARY	xiv
1.0 INTRODUCTION	1-1
1.1 SITE BACKGROUND	1-3
1.2 NATURE AND EXTENT OF THE PROBLEM	1-5
1.3 INVESTIGATION SUMMARY	1-7
1.4 REPORT OVERVIEW	1-8
2.0 ENVIRONMENTAL SETTING	2-1
2.1 PHYSICAL ENVIRONMENT	2-1
2.1.1 PHYSIOGRAPHY AND SURFACE WATER	2-1
2.1.2 CLIMATE	2-2
2.2 REGIONAL BIOTA	2-4
2.2.1 MAJOR ECOSYSTEMS	2-5
2.2.1.1 Terrestrial Ecosystems	2-5
2.2.1.2 Aquatic Ecosystems	2-11
2.2.2 RELATIONSHIP TO REGIONAL LAND USES	2-13
2.3 STUDY AREA	2-16
2.3.1 TERRESTRIAL ECOSYSTEMS	2-16
2.3.1.1 Vegetation	2-16
2.3.1.2 Wildlife	2-19
2.3.2 AQUATIC ECOSYSTEMS	2-25
2.3.2.1 Lakes and Ponds	2-26
2.3.2.2 Streams	2-28
3.0 SAMPLING AND ANALYSIS PROGRAM	3-1
3.1 PHASE I INVESTIGATION	3-1
3.1.1 OBJECTIVES	3-1
3.1.2 METHODS	3-2
3.1.2.1 Preliminary Assessment	3-2
3.1.2.2 Selection Criteria Development	3-3
3.1.2.3 Contamination Assessment	3-3
3.2 PHASE II INVESTIGATIONS	3-5
3.2.1 OBJECTIVES	3-5
3.2.2 METHODS	3-5
3.2.2.1 Collection Sites	3-6
3.2.2.2 Field Investigations	3-10
3.2.2.3 Contaminant Analysis	3-30
3.2.2.4 Contaminant Pathways and Acceptable Criteria Development	3-33
3.2.2.5 General Methodology for Pathway Analysis	3-36

05/04/89

TABLE OF CONTENTS

Section	Page
3.3 SUPPLEMENTAL STUDIES	3-43
3.3.1 VEGETATION	3-43
3.3.2 AQUATIC STUDIES	3-55
3.3.3 WILDLIFE STUDIES	3-60
4.0 NATURE AND EXTENT OF BIOLOGICAL CONTAMINATION	4-1
4.1 CONTAMINATION HISTORY	4-2
4.1.1 CONTAMINATION HISTORY OF THE BASINS	4-2
4.1.2 HISTORY OF THE LOWER LAKES	4-6
4.1.3 HISTORICAL CONTAMINATION LEVELS IN WILDLIFE	4-8
4.2 DEFINITION OF CONTAMINANTS	4-25
4.3 CURRENT EXTENT OF CONTAMINATION IN BIOTA	4-26
4.3.1 PHASE I RESULTS	4-26
4.3.2 CONTAMINANTS IN TERRESTRIAL ECOSYSTEMS	4-27
4.3.2.1 Vegetation	4-32
4.3.2.2 Invertebrates	4-32
4.3.2.3 Vertebrates	4-36
4.3.3 CONTAMINANTS IN AQUATIC ECOSYSTEMS	4-59
4.3.3.1 Documentation of Previous Contamination in Sediment and Aquatic Biota	4-59
4.3.3.2 Contamination in Aquatic Biota in Lower Derby Lake	4-61
4.3.3.3 Contamination in Aquatic Biota in Ladora Lake	4-67
4.3.3.4 Contamination in Aquatic Biota in Lake Mary	4-68
4.3.3.5 Statistical Review of Biotic Contamination Data	4-70
VOLUME II	
5.0 CONTAMINATION ASSESSMENT	5-1
5.1 TOXICITY ASSESSMENTS OF CONTAMINANTS OF CONCERN	5-5
5.1.1 ALLYL CHLORIDE	5-11
5.1.1.1 Aquatic Ecosystems	5-13
5.1.1.2 Terrestrial Ecosystems	5-13
5.1.1.3 Quantification of Toxic Effects	5-13
5.1.2 ATRAZINE	5-14
5.1.2.1 Aquatic Ecosystems	5-14
5.1.2.2 Terrestrial Ecosystems	5-15
5.1.2.3 Quantification of Toxic Effects	5-17
5.1.3 AZODRIN (MONOCROTOPHOS)	5-18
5.1.3.1 Aquatic Ecosystems	5-18
5.1.3.2 Terrestrial Ecosystems	5-18
5.1.3.3 Quantification of Toxic Effects	5-20

TABLE OF CONTENTS

Section		Page
5.1.4	CADMIUM	5-20
	5.1.4.1 Aquatic Ecosystems	5-21
	5.1.4.2 Terrestrial Ecosystems	5-22
	5.1.4.3 Quantification of Toxic Effects	5-24
5.1.5	CHLORDANE/OXYCHLORDANE	5-26
	5.1.5.1 Aquatic Ecosystems	5-26
	5.1.5.2 Terrestrial Ecosystems	5-27
	5.1.5.3 Quantification of Toxic Effects	5-29
5.1.6	CHLOROBENZENE	5-30
	5.1.6.1 Aquatic Ecosystems	5-30
	5.1.6.2 Terrestrial Ecosystems	5-32
	5.1.6.3 Quantification of Toxic Effects	5-33
5.1.7	CHLOROFORM	5-34
	5.1.7.1 Aquatic Ecosystems	5-34
	5.1.7.2 Terrestrial Ecosystems	5-35
	5.1.7.3 Quantification of Toxic Effects	5-36
5.1.8	CHLOROPHENYL METHYL SULFIDE, CHLOROPHENYL SULFOXIDE, CHLOROPHENYL SULFONE (CPMS, CPMSO, CPMSO ₂)	5-37
	5.1.8.1 Aquatic Ecosystems	5-37
	5.1.8.2 Terrestrial Ecosystems	5-37
	5.1.8.3 Quantification of Toxic Effects	5-39
5.1.9	COPPER	5-40
	5.1.9.1 Aquatic Ecosystems	5-40
	5.1.9.2 Terrestrial Ecosystems	5-42
	5.1.9.3 Quantification of Toxic Effects	5-44
5.1.10	DICHLORODIPHENYLTRICHLOROETHANE (DDT)/ 1,1-DICHLORO-2,2-BIS(4-CHLOROPHENYL)-ETHYLENE (DDE)	5-45
	5.1.10.1 Aquatic Ecosystems	5-46
	5.1.10.2 Terrestrial Ecosystems	5-47
	5.1.10.3 Quantification of Toxic Effects	5-50
5.1.11	DICYCLOPENTADIENE (DCPD)	5-51
	5.1.11.1 Aquatic Ecosystems	5-51
	5.1.11.2 Terrestrial Ecosystems	5-52
	5.1.11.3 Quantification of Toxic Effects	5-53
5.1.12	DIISOPROPYLMETHYL PHOSPHONATE (DIMP)	5-54
	5.1.12.1 Aquatic Ecosystems	5-54
	5.1.12.2 Terrestrial Ecosystems	5-54
	5.1.12.3 Quantification of Toxic Effects	5-56
5.1.13	DIMETHYLMETHYL PHOSPHONATE (DMMP)	5-57
	5.1.13.1 Aquatic Ecosystems	5-58
	5.1.13.2 Terrestrial Ecosystems	5-58
	5.1.13.3 Quantification of Toxic Effects	5-59
5.1.14	DITHIANE	5-60
	5.1.14.1 Aquatic Ecosystems	5-60
	5.1.14.2 Terrestrial Ecosystems	5-60
	5.1.14.3 Quantification of Toxic Effects	5-61

TABLE OF CONTENTS

Section	Page
5.1.15 ETHYLBENZENE	5-62
5.1.15.1 Aquatic Ecosystems	5-62
5.1.15.2 Terrestrial Ecosystems	5-63
5.1.15.3 Quantification of Toxic Effects	5-64
5.1.16 HEPTACHLOR/HEPTACHLOR EPOXIDE	5-65
5.1.16.1 Aquatic Ecosystems	5-66
5.1.16.2 Terrestrial Ecosystems	5-67
5.1.16.3 Quantification of Toxic Effects	5-68
5.1.17 MALATHION	5-70
5.1.17.1 Aquatic Ecosystems	5-70
5.1.17.2 Terrestrial Ecosystems	5-71
5.1.17.3 Quantification of Toxic Effects	5-73
5.1.18 METHYL PARATHION	5-73
5.1.18.1 Aquatic Ecosystems	5-74
5.1.18.2 Terrestrial Ecosystems	5-74
5.1.18.3 Quantification of Toxic Effects	5-76
5.1.19 METHYLPHOSPHONIC ACID (MPA)	5-77
5.1.19.1 Aquatic Ecosystems	5-77
5.1.19.2 Terrestrial Ecosystems	5-77
5.1.19.3 Quantification of Toxic Effects	5-78
5.1.20 MUSTARD	5-79
5.1.20.1 Aquatic Ecosystems	5-79
5.1.20.2 Terrestrial Ecosystems	5-79
5.1.20.3 Quantification of Toxic Effects	5-80
5.1.21 NITROSODIMETHYLAMINE (DMNA)	5-81
5.1.21.1 Aquatic Ecosystems	5-81
5.1.21.2 Terrestrial Ecosystems	5-82
5.1.21.3 Quantification of Toxic Effects	5-83
5.1.22 1,4-OXATHIANE	5-84
5.1.22.1 Aquatic Ecosystems	5-84
5.1.22.2 Terrestrial Ecosystems	5-84
5.1.22.3 Quantification of Toxic Effects	5-84
5.1.23 PARATHION	5-85
5.1.23.1 Aquatic Ecosystems	5-86
5.1.23.2 Terrestrial Ecosystems	5-87
5.1.23.3 Quantification of Toxic Effects	5-88
5.1.24 POLYCHLORINATED BIPHENYLS (PCBs)	5-89
5.1.24.1 Aquatic Ecosystems	5-89
5.1.24.2 Terrestrial Ecosystems	5-90
5.1.24.3 Quantification of Toxic Effects	5-93
5.1.25 TOLUENE	5-94
5.1.25.1 Aquatic Ecosystems	5-94
5.1.25.2 Terrestrial Ecosystems	5-94
5.1.25.3 Quantification of Toxic Effects	5-96
5.1.26 TRICHLOROETHYLENE	5-97
5.1.26.1 Aquatic Ecosystems	5-97
5.1.26.2 Terrestrial Ecosystems	5-98
5.1.26.3 Quantification of Toxic Effects	5-99

TABLE OF CONTENTS

Section	Page
5.1.27 XYLENE	5-100
5.1.27.1 Aquatic Ecosystems	5-100
5.1.27.2 Terrestrial Ecosystems	5-101
5.1.27.3 Quantification of Toxic Effects	5-102
5.2 PATHWAYS ANALYSES FOR MAJOR CONTAMINANTS OF CONCERN	5-104
5.2.1 PATHWAYS ANALYSIS FOR ALDRIN/DIELDRIN	5-110
5.2.1.1 Background Information	5-110
5.2.1.2 Surface Water Ingestion	5-117
5.2.1.3 Aquatic Life	5-120
5.2.1.4 Aquatic Pathway Analysis	5-120
5.2.1.5 Terrestrial Pathway Analysis	5-143
5.2.1.6 Uncertainty Analysis	5-157
5.2.1.7 Summary and Conclusions	5-161
5.2.2 PATHWAYS ANALYSIS FOR ARSENIC	5-162
5.2.2.1 Background Information	5-162
5.2.2.2 Surface Water Ingestion	5-168
5.2.2.3 Aquatic Life	5-171
5.2.2.4 Aquatic Pathway Analysis	5-171
5.2.2.5 Terrestrial Pathway Analysis	5-188
5.2.2.6 Uncertainty Analysis	5-191
5.2.2.7 Summary and Conclusions	5-194
5.2.3 PATHWAYS ANALYSIS FOR DIBROMOCHLOROPROPANE (DBCP)	5-195
5.2.3.1 Background Information	5-195
5.2.3.2 Surface Water Ingestion	5-199
5.2.3.3 Aquatic Life	5-202
5.2.3.4 Aquatic Pathway Analysis	5-202
5.2.3.5 Terrestrial Pathway Analysis	5-218
5.2.3.6 Uncertainty Analysis	5-222
5.2.3.7 Summary and Conclusions	5-226
5.2.4 PATHWAYS ANALYSIS FOR ENDRI/ISODRI	5-227
5.2.4.1 Background Information	5-227
5.2.4.2 Surface Water Ingestion	5-235
5.2.4.3 Aquatic Life	5-237
5.2.4.4 Aquatic Pathway Analysis	5-238
5.2.4.5 Terrestrial Ecosystems	5-255
5.2.4.6 Uncertainty Analysis	5-258
5.2.4.7 Summary and Conclusions	5-263
5.2.5 PATHWAYS ANALYSIS FOR MERCURY	5-264
5.2.5.1 Background Information	5-264
5.2.5.2 Surface Water Ingestion	5-274
5.2.5.3 Aquatic Life	5-276
5.2.5.4 Aquatic Pathway Analysis	5-277
5.2.5.5 Terrestrial Pathways Analysis	5-298
5.2.5.6 Uncertainty Analysis	5-304
5.2.5.7 Summary and Conclusions	5-306

TABLE OF CONTENTS

Section	Page
5.3 CONTAMINANT EFFECTS	5-308
5.3.1 TERRESTRIAL VEGETATION	5-308
5.3.1.1 Community Ecology	5-308
5.3.1.2 Effects of Contaminant Levels in Terrestrial Plants	5-309
5.3.2 INVERTEBRATES	5-310
5.3.2.1 Aquatic Snails Populations	5-310
5.3.2.2 Grasshopper Populations	5-311
5.3.2.3 Earthworms Populations	5-313
5.3.3 VERTEBRATES	5-314
5.3.3.1 Brain Acetylcholinesterase Inhibition	5-314
5.3.3.2 Black-tailed Prairie Dog Populations	5-316
5.3.3.3 Eagles and Other Birds of Prey	5-325
5.3.3.4 Avian Reproduction Success	5-334
5.3.3.5 Other Species and Contaminant Effects	5-345
5.3.4 AQUATIC ECOSYSTEMS	5-349
5.3.4.1 Bioaccumulation in Aquatic Ecosystems	5-351
5.3.4.2 Effects of Contamination in RMA Aquatic Communities	5-354
6.0 GLOSSARY	6-1
VOLUME III	
7.0 REFERENCES CITED	7-1
APPENDICES	
APPENDIX A--PLANT AND ANIMAL SPECIES WHICH INHABIT OR POTENTIALLY OCCUR ON ROCKY MOUNTAIN ARSENAL	
APPENDIX B--STATISTICAL ANALYSES	
APPENDIX C--LITERATURE REVIEW: THE USE OF PESTICIDES AND HERBICIDES BY THE ARMY FOR THE CONTROL OF PESTS AND VEGETATION AT ROCKY MOUNTAIN ARSENAL	
APPENDIX D--CHEMICAL DATA	
VOLUME IV	
APPENDIX E--COMMENTS AND RESPONSES TO THE BIOTA REMEDIAL INVESTIGATION, DRAFT FINAL REPORT (VERSION 2.2) JANUARY 1989	

LIST OF FIGURES

Figure		Page
1.1-1	Location Map of Rocky Mountain Arsenal	1-2
1.1-2	Basins and Water Bodies on RMA	1-6
2.1-1	Surface Waters On and Near RMA	2-3
2.2-1	RMA and Surrounding Land Uses	2-14
2.3-1	Study Area Boundaries	2-17
2.3-2	Vegetation Map of Rocky Mountain Arsenal	2-18
2.3-3	Raptor Nests Located on RMA in 1986 and 1987	2-24
3.2-1	RMA Offpost Control Site Locations	3-8
3.2-2	RMA Prairie Dog Colonies	3-17
3.2-3	Locations and Numbers of American Kestrel Nest Boxes on the RMA Observed for Productivity and Chemical Concentrations in Eggs and Young in 1986	3-22
3.2-4	Offpost Kestrel Nest Box Locations	3-23
3.2-5	Locations of Active Kestrel Nest Boxes on the RMA in 1986	3-24
3.2-6a	Locations of Ring-Necked Pheasant Brood Count Routes in Northeastern Larimer County (Control) During 1986	3-25
3.2-6b	Locations of Ring-Necked Pheasant Brood Count Routes on the RMA During 1986	3-26
3.2-7a	Locations of Lakes for Waterfowl Counts in Northeastern Larimer County (Control) During 1986	3-27
3.2-7b	Locations of Lakes for Waterfowl Counts on the RMA During 1986	3-28
3.2-8	Locations of RMA Ring-Necked Pheasant and Mallard Nests from Which Eggs Were Collected in 1986	3-29
3.2-9	Bioaccumulation Model Indicating Contaminant Concentration as a Function of Accumulation from Water and Net Uptake by the Next Lower Trophic Level	3-38
4.3-1	Contaminant Levels in RMA Terrestrial Plants	4-33
4.3-2	Contaminant Levels in RMA Invertebrates	4-34

LIST OF FIGURES

Figure		Page
4.3-3	Contaminant Levels in American Kestrel Eggs from RMA	4-39
4.3-4	Contaminant Levels in American Kestrel Fledgling Carcasses from RMA	4-40
4.3-5	Contaminant Levels in Raptors and Carnivores from RMA	4-41
4.3-6	Contaminant Levels in RMA Mallard Eggs and Carcasses	4-45
4.3-7	Contaminant Levels in Waterfowl and Mourning Doves from RMA	4-46
4.3-8	Contaminant Levels in Ring-necked Pheasants from RMA	4-48
4.3-9	Contaminant Levels in Pheasant Eggs from RMA	4-49
4.3-10	Contaminant Levels of Cottontail Muscle Tissue from RMA	4-52
4.3-11	Locations and Contaminant Levels of RMA Mule Deer	4-53
4.3-12	Contaminant Levels of Black-tailed Prairie Dog Carcasses from RMA	4-55
4.3-13	Contaminant Levels of Black-tailed Prairie Dog (Skeletal Muscle and Viscera) from RMA	4-57
5.0-1	Methodology for Determining Ecological Criteria	5-2
5.1-1	Methodology for Determining Water Criteria for Other Contaminants of Concern	5-6
5.1-2	Methodology for Determining Soil Criteria for Other Contaminants of Concern	5-7
5.2-1	Methodology for Determining Criteria for Major Contaminants of Concern	5-105
5.2-2	Bald Eagle Sink Food Web for Dieldrin	5-126
5.2-3	Kestrel Sink Food Web for Dieldrin	5-150
5.2-4	Bald Eagle Sink Food Web for Arsenic	5-176
5.2-5	Bald Eagle Sink Food Web for DBCP	5-206
5.2-6	Bald Eagle Sink Food Web for Endrin	5-242
5.2-7	Bald Eagle Sink Food Web for Mercury	5-279

LIST OF FIGURES

Figure		Page
5.3-1	RMA Prairie Dog Colonies	5-319
5.3-2	RMA Prairie Dog Colonies and Shallow Ground Water Contours	5-320
5.3-3	Locations for Sediment Sampling in Offpost Operable Unit	5-328
5.3-4	Rocky Mountain Arsenal Bald Eagle Feeding Observations, Winter 1986-1987	5-330
5.3-5	Rocky Mountain Arsenal Bald Eagle Feeding Observations, Winter, 1987-1988	5-331

LIST OF TABLES

Table		Page
1.3-1	Wildlife Injury Incidents, Miscellaneous or Unknown Locations (1949 to 1982)	1-9
3.2-1	Important Species Potentially Occurring On or Near Rocky Mountain Arsenal	3-11
3.2-2	Species and Contaminants for Tissue Analysis	3-34
3.3-1	Summary of Quantitative Vegetation Data for Major Vegetation Types, RMA, 1986	3-46
4.1-1	Annual Waterfowl Mortality at Basin F From 1981 to 1987	4-5
4.1-2	Contaminants Recorded From Biota From the Lower Lakes (Lake Mary, Lake Ladora, Lower Derby, and Upper Derby)	4-9
4.1-3	Contaminants Recorded From Biota in Section 36	4-13
4.1-4	Contaminants From Biota in Section 24	4-15
4.1-5	Contaminants Recorded From Biota in Section 26	4-17
4.1-6	Contaminants in Biota From Sections 6, 7, 11, 12, 19, 23, 30, and 35	4-19
4.3-1	Contaminant Levels in Terrestrial Ecosystems - Terrestrial Program Samples	4-28
4.3-2	Contaminant Levels in Terrestrial Ecosystems - Miscellaneous Samples: Samples of Chance and USFWS Supplemental Samples	4-30
4.3-3	Certified Reporting Limits for Biota Analysis Methods	4-31
4.3-4	Contaminant Levels in Black-tailed Prairie Dogs Collected by MKE	4-58
4.3-5	Contaminant Levels in Aquatic Ecosystems	4-62
4.3-6	Nonstatistical Comparisons of Mercury and Dieldrin Concentrations for Individual Bass and Bluegill Whole Bodies in Relation to Weight	4-75
5.1-1	Water and Food Intake Values for Birds and Mammals Used in Establishing Acceptable Water Concentrations	5-9
5.1-2	Uncertainty Factors Used in Establishing Acceptable Water Concentrations	5-10

LIST OF TABLES

Table		Page
5.1-3	Acceptable Concentrations in Abiotic Media	5-12
5.2-1	Acceptable Concentrations of the Major Contaminants of Concern in the Abiotic Media	5-1065
5.2-2	Toxic Effects Levels of Dieldrin for Mammals and Birds by Ingestion	5-118
5.2-3	Summary of Feeding Habits for Dieldrin Pathways Analysis	5-122
5.2-4	Bioconcentration Factors Used in the Pathways Analysis Component for Dieldrin	5-124
5.2-5	Summary of Bioaccumulation or Biomagnification Factors for Each Species in the Pathways Analysis for Dieldrin	5-139
5.2-6	Total Biomagnification of Dieldrin Residues for Each of the Key Organisms in the Aquatic Pathways Analysis	5-140
5.2-7	Bioaccumulation Factors Used in the Terrestrial Pathway Component of the Aquatic Pathways Analyses for Dieldrin	5-145
5.2-8	Summary of Feeding Habits for All Organisms in the Terrestrial Pathways Analysis for Dieldrin	5-148
5.2-9	Bioaccumulation Factors Used in the Pathway Analysis for Dieldrin	5-151
5.2-10	Biomagnification Factors for Each Food Chain in the Pathways Analysis for Dieldrin	5-154
5.2-11	Biomagnification Factors for Each Pathway Following Adjustment for Dietary Proportions, Dieldrin Pathways Analysis	5-156
5.2-12	Dietary Input Factors, Dieldrin Pathways Analysis	5-159
5.2-13	Toxic Effects Levels of Arsenic for Mammals and Birds by Ingestion	5-169
5.2-14	Summary of Feeding Habits, Pathways Analysis for Arsenic	5-172
5.2-15	Bioconcentration Factors Used in the Pathways Analysis for Arsenic	5-173
5.2-16	Summary of Bioaccumulation Factors for Each Species in the Pathways Analysis for Arsenic	5-182
5.2-17	Total Biomagnification of Arsenic Residues for Each of the Key Organisms in the Aquatic Pathways Analysis	5-187

LIST OF TABLES

Table		Page
5.2-18	Dietary Input Factors, Pathways Analysis for Arsenic	5-193
5.2-19	Bioconcentration Factors as Predicted by Regression Techniques, DBCP Pathways Analysis	5-198
5.2-20	Toxic Effects Levels of DBCP for Small Mammals and Birds by Ingestion	5-200
5.2-21	Summary of Feeding Habits for DBCP Pathways Analysis	5-205
5.2-22	Summary of Bioaccumulation Factors for Each Species in the DBCP Pathways Analysis	5-215
5.2-23	Total Biomagnification of DBCP Residues for Each of the Key Organisms in the Aquatic Pathways Analysis	5-216
5.2-24	Concentration Factors Over Time for Carrot and Radish Crops When DBCP Was Applied to Soil at Seeding	5-219
5.2-25	Dietary Input Factors, DBCP Pathways Analysis	5-224
5.2-26	Toxic Effect Levels of Endrin for Small Mammals and Birds by Ingestion	5-236
5.2-27	Summary of Feeding Habits for the Pathway Analysis for Endrin	5-239
5.2-28	Bioconcentration Factors Used in the Endrin Pathways Analysis	5-241
5.2-29	Summary of Bioaccumulation Factors for Each Pathway for Species in the Endrin Pathways Analysis	5-251
5.2-30	Total Biomagnification of Endrin Residues for Each of the Key Organisms in the Aquatic Pathways Analysis	5-253
5.2-31	Bioaccumulation Factors for the Terrestrial Food Chain, Pathways Analysis for Endrin	5-256
5.2-32	Dietary Input Factors, Endrin Pathways Analysis	5-259
5.2-33	BCFs Used to Perform the Uncertainty Analysis, Endrin Pathways Analysis	5-261
5.2-34	Toxic Effects Levels of Mercury in Mammals and Birds by Ingestion	5-275
5.2-35	Bioconcentration Factors for Mercury Used in the Pathways Analysis	5-282

LIST OF TABLES

Table		Page
5.2-36	Summary of Feeding Habits, Pathways Analysis for Mercury	5-283
5.2-37	Assimilation Efficiencies for Fish and Birds Fed Methylmercury	5-285
5.2-38	Methylmercury Loss Rates for Various Species	5-286
5.2-39	Summary of Bioaccumulation Factors for Each Species in the Pathways Analysis for Mercury	5-294
5.2-40	Total Biomagnification of Mercury Residues for Each of the Key Organisms in the Aquatic Pathways Analysis	5-295
5.2-41	Toxic Effects of Methylmercury on Birds	5-297
5.2-42	Bioaccumulation Factors for Mercury for Terrestrial Species in the Pathways Analysis	5-300
5.2-43	Dietary Input Factors, Mercury Pathways Analysis	5-305
5.3-1	Summer 1987 Population Estimates for Black-tailed Prairie Dogs on RMA	5-317
5.3-2	Prairie Dog Population Mean (per hectare) and Confidence Limits for Summer 1987	5-318
5.3-3	January 1988 Survey: Active Prairie Dogs per Hectare	5-321
5.3-4	Percent of Young Prairie Dogs at Each Sampling Location	5-323
5.3-5	Brain/Liver Contaminant Concentrations and Necropsy Results for Rocky Mountain Arsenal Raptors	5-333
5.3-6	Nesting Productivity of American Kestrels on RMA and Off (Control) During 1986 and in Earlier Studies (1982, 1983)	5-336
5.3-7	Mean Measurements of Eggs Collected on RMA and at Control Sites During 1986	5-338
5.3-8	Concentrations (Arithmetic Means, $\mu\text{g/g}^{-1}$, Wet-weight Basis) of Predominant Organochlorine (OC) Chemicals and Metals Detected During 1986 in Eggs From the Colorado Rocky Mountain Arsenal (RMA) and Control Sites	5-339
5.3-9	Concentrations (Arithmetic Means, $\mu\text{g/g}^{-1}$, Wet-weight Basis) of Predominant Organochlorine (OC) Chemicals and Metals Detected During 1986 in Carcasses From the Colorado Rocky Mountain Arsenal (RMA) and Control Sites	5-341

LIST OF TABLES

Table		Page
5.3-10	Ring-necked Pheasant Brood Counts Conducted on 6-Mile Long Routes on the Colorado Rocky Mountain Arsenal (RMA) and in Northeastern Larimer County (Control) During 1986	5-342
5.3-11	Mean Number of Waterfowl Counted at the Colorado Rocky Mountain Arsenal (RMA) and in Northeastern Larimer County (Control) During 1986	5-343

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APPENDIX A

PLANT AND ANIMAL SPECIES WHICH INHABIT OR POTENTIALLY
OCCUR ON ROCKY MOUNTAIN ARSENAL

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 1 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
PLANTS					
Aceraceae	Acer	saccharinum	Silver-leaf maple		
Aceraceae	Negundo	aceroides	Boxelder		
Algae	Chara	kieneri	Muskgrass		X
Alismataceae	Alisma	plantagoaquatica	Water-paintain		X
Alismataceae	Sagittaria	cuneata	Arrowhead		X
Amaranthaceae	Amaranthus	albus	Tumble pigweed		X
Amaranthaceae	Amaranthus	arenicola	Rope-spike pigweed		X
Amaranthaceae	Amaranthus	gracilans	Prostrate pigweed		X
Amaranthaceae	Amaranthus	retroflexus	Rough pigweed		X
Amaranthaceae	Eriogonum	gracilis	Froelichia		X
Anacardiaceae	Rhus	trilobata	Skunkbrush		X
Apocynaceae	Apocynum	sibiricum	Siberian dogbane		X
Asclepiadaceae	Asclepias	incarnata	Marsh milkweed		X
Asclepiadaceae	Asclepias	pumilus	Little milkweed		X
Asclepiadaceae	Asclepias	speciosa	Showy milkweed		X
Asclepiadaceae	Asclepias	subverticillata	Whorled milkweed		X
Asclepiadaceae	Asclepias	viridiflora	Green milkweed		X
Asparagaceae	Asparagus	officinalis	Asparagus		X
Bignoniaceae	Catalpa	speciosa	Snowy catalpa		X
Boraginaceae	Cryptantha	fendleri	Fendler's cryptantha		X
Boraginaceae	Cryptantha	minima	Small cryptantha		X
Boraginaceae	Lappula	radowskii	Stickweed		X
Boraginaceae	Lithospermum	lucisum	Narrow-leaf puccoon		X
Cactaceae	Coryphantha	vivipara	Ball cactus		X
Cactaceae	Echinocereus	viridiflorus	Hen and chickens		X
Cactaceae	Opuntia	compressa	Prickly pear		X
Cactaceae	Opuntia	polyacantha	Plains prickly pear		X
Cactaceae	Opuntia	sarrulata	Beeweed		X
Capparidaceae	Cleome	dodecandra	Clammy weed		X
Capparidaceae	Polanisia	occidentalis	Snowberry		X
Caprifoliaceae	Symphoricarpos	paniculata	Baby's breath		X
Caryophyllaceae	Gypsophila	officinalis	Bouncing Bet		X
Caryophyllaceae	Saponaria	damersum	Hornwort		X
Ceratophyllaceae	Ceratophyllum				

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 2 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Chenopodiaceae	Atriplex	bastata	Spear orache		X
Chenopodiaceae	Bassia	byssopifolia	Bassia		X
Chenopodiaceae	Ceratoides	lanata	Winterfat		X
Chenopodiaceae	Chenopodium	album	Pigweed		X
Chenopodiaceae	Chenopodium	leptophyllum	Narrow-leaf goosefoot		X
Chenopodiaceae	Chenopodium	rubrum	Red goosefoot		X
Chenopodiaceae	Cyclopoma	atriplicifolium	Winged pigweed		X
Chenopodiaceae	Kochia	iranica	Kochia		X
Chenopodiaceae	Salsola	collina	Russian thistle		X
Chenopodiaceae	Salsola	iberica	Russian thistle		X
Comelinaceae	Tradescantia	occidentalis	Western spiderwort		X
Compositae	Ambrosia	acanthicarpa	Sand bur		X
Compositae	Ambrosia	psilostachya	Western ragweed		X
Compositae	Ambrosia	tomentosa	Spiny bursage		X
Compositae	Ambrosia	trifida	Clant ragweed		X
Compositae	Anaphalis	margaritacea	Pearly everlasting		X
Compositae	Antennaria	rosea	Pussy-toes		X
Compositae	Artemisia	tridentata	Big sagebrush		X
Compositae	Artemisia	biennis	Biennial wormwood		X
Compositae	Artemisia	dracunculius	Green sage		X
Compositae	Artemisia	filifolia	Sand sagebrush		X
Compositae	Artemisia	frigida	Fringed sagebrush		X
Compositae	Artemisia	ludoviciana	Prairie sage		X
Compositae	Aster	ericoides	Heath aster		X
Compositae	Aster	falcatus	White prairie aster		X
Compositae	Aster	hesperius	Aster		X
Compositae	Bidens	cernua	Nodding bur-marigold		X
Compositae	Bidens	gracilis	Beggars ticks		X
Compositae	Carduus	nutans	Musk thistle		X
Compositae	Centaurea	repens	Russian knapweed		X
Compositae	Chrysanthemum	nauseosus	Rabbitbrush		X
Compositae	Cirsium	arvense	Canadian thistle		X
Compositae	Cirsium	canescens	Hoary thistle		X
Compositae	Cirsium	undulatum	Wavy-leaved thistle		X
Compositae	Cirsium	vulgare	Bull thistle		X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 3 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Compositae	Conyza	canadensis	Horseweed		X
Compositae	Dysodia	papposa	Fetid marigold		X
Compositae	Erigeron	divergens	Spreading fleabane		X
Compositae	Erigeron	pumilus	Low daisy		X
Compositae	Euthamia	occidentalis	Bushy goldenrod		X
Compositae	Erax	prolifera	Fluffweed		X
Compositae	Grappallium	chilense	Yellow cudweed		X
Compositae	Grappallium	exilifolium	Cudweed		X
Compositae	Grappallium	wrightii	Everlasting		X
Compositae	Grindelia	squarrosa	Gumweed		X
Compositae	Gutierrezia	sarothrae	Snakeweed		X
Compositae	Haplopappus	spinulosus	Spiny goldenweed		X
Compositae	Hellanthus	annuus	Common sunflower		X
Compositae	Hellanthus	petiolaris	Prairie sunflower		X
Compositae	Heterotheca	villosa	Hairy golden aster		X
Compositae	Iva	xanthifolia	Tall marsh elder		X
Compositae	Kuhnia	eupatorioides	False boneset		X
Compositae	Lactuca	serriola	Prickly lettuce		X
Compositae	Lactuca	tatarica	Large flower blue lettuce		X
Compositae	Liatris	punctata	Blazing star		X
Compositae	Lygodesmia	junceae	Rush skeleton weed		X
Compositae	Machaeranthera	canescens	Silvery aster		X
Compositae	Machaeranthera	pattersoni	Patterson aster		X
Compositae	Machaeranthera	pinnatifida	Ironplant goldenweed		X
Compositae	Nothocalais	cuspidata	False dandelion		X
Compositae	Onopordum	acanthium	Scotch thistle		X
Compositae	Picradeniopsis	oppositifolia	Plains bahia		X
Compositae	Podospermum	laciniatum	Podospermum		X
Compositae	Ratibida	columifera	Prairie coneflower		X
Compositae	Senecio	plattensis	Platte groundsel		X
Compositae	Senecio	spartioides	Butterweed		X
Compositae	Senecio	tridenticulatus	3-toothed butterweed		X
Compositae	Solidago	altissima	Tall goldenrod		X
Compositae	Solidago	canadensis	Canada goldenrod		X
Compositae	Solidago	gigantea	Giant goldenrod		X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 4 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED	
					ON PMA	ON PMA
Compositae	Solidago	Missouriensis	Missouri goldenrod		X	
Compositae	Solidago	mollis	Soft goldenrod		X	
Compositae	Solidago	speciosa	Showy goldenrod		X	
Compositae	Sonchus	asper	Spiny Sow-thistle		X	
Compositae	Sonchus	uliginosus	Sow thistle		X	
Compositae	Stephanomeria	pauciflora	Wire lettuce		X	
Compositae	Taraxacum	officinale	Dandelion		X	
Compositae	Thelespisma	megapotamicum	Greenthread		X	
Compositae	Tragopogon	dubius	Yellow salsify		X	
Compositae	Verbesina	enceloides	Crownbeard		X	
Compositae	Xanthium	strumarium	Cocklebur		X	
Convolvulaceae	Convolvulus	arvensis	Morning glory		X	
Convolvulaceae	Evolvulus	nuttallianus	Bindweed		X	
Convolvulaceae	Ipomoea	leptophylla	Bush morning glory		X	
Cruciferae	Alyssum	desertorum	Desert Alyssum		X	
Cruciferae	Alyssum	minus	Alyssum		X	
Cruciferae	Cardaria	draba	Hoary cress		X	
Cruciferae	Chorispora	tenella	Common blue mustard		X	
Cruciferae	Descurainia	pinnata	Tansy mustard		X	
Cruciferae	Descurainia	richardsonii	Western tansy mustard		X	
Cruciferae	Descurainia	sophia	Tansy mustard		X	
Cruciferae	Draba	reptans	White draba		X	
Cruciferae	Eleocharis	acicularis	Slender spikerush		X	
Cruciferae	Eleocharis	macrostachya	Common spikerush		X	
Cruciferae	Erysimum	asperum	Western wallflower		X	
Cruciferae	Lepidium	densiflorum	Prairie peppergrass		X	
Cruciferae	Lepidium	perfoliatum	Peppergrass		X	
Cruciferae	Lesquerella	ludoviciana	Bladderpod		X	
Cruciferae	Nasturtium	officinale	Watercress		X	
Cruciferae	Rorippa	palustis	Cress		X	
Cruciferae	Rorippa	sinuata	Yellow-cress		X	
Cruciferae	Rorippa	terres	Cress		X	
Cruciferae	Sisymbrium	altissimum	Tumble mustard		X	
Cruciferae	Sisymbrium	officinale	Hedge mustard		X	
Cruciferae	Thlaspi	arvense	Penny-cress		X	

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 5 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Cucurbitaceae	Cucurbita	foetidissima	Wild gourd		X
Cucurbitaceae	Echinocystis	labata	Mock cucumber		X
Cyperaceae	Carex	filifolia	Threadleaf sedge		X
Cyperaceae	Carex	heliophila	Sun sedge		X
Cyperaceae	Carex	nebraskensis	Nebraska sedge		X
Cyperaceae	Carex	praegracilis	Sedge		X
Cyperaceae	Cyperus	erythrorhizos	Calingale		X
Cyperaceae	Eleocharis	acicularis	Slender spikerush		X
Cyperaceae	Eleocharis	macrostachya	Common spikerush		X
Cyperaceae	Mariscus	schweinitzii	Mariscus		X
Cyperaceae	Scirpus	acutus	Compact bullrush		X
Cyperaceae	Scirpus	americanus	American bullrush		X
Cyperaceae	Scirpus	lacustris	Tule		X
Cyperaceae	Scirpus	paludosus	Alkali bullrush		X
Eleagnaceae	Eleagnus	angustifolia	Russian olive		X
Equisetaceae	Hippochaeris	laevigata	Scouring rush		X
Euphorbiaceae	Chamaesyce	glyptosperma	Corrugate-seed spurge		X
Euphorbiaceae	Chamaesyce	missurica	Narrow-leave spurge		X
Euphorbiaceae	Chamaesyce	serpyllifolia	Thyme-leaved spurge		X
Euphorbiaceae	Croton	texensis	Croton		X
Euphorbiaceae	Euphorbia	esula	Spurge		X
Euphorbiaceae	Euphorbia	marginata	Snow-on-the-mountain		X
Euphorbiaceae	Euphorbia	spatulata	Spurge		X
Ceraniaceae	Erodium	cicutarium	Fillaree		X
Gramineae	Agropyron	crispatum	Crested wheatgrass		X
Gramineae	Agropyron	desertorum	Crested wheatgrass		X
Gramineae	Agropyron	elongatum	Tall wheatgrass		X
Gramineae	Agropyron	intermedium	Intermed. wheatgrass		X
Gramineae	Agropyron	repens	Quack grass		X
Gramineae	Agropyron	smithii	Western wheatgrass		X
Gramineae	Agropyron	trachycaulum	Slender wheatgrass		X
Gramineae	Agrostis	gigantea	Redtop		X
Gramineae	Andropogon	hallii	Sandhillis bluestem		X
Gramineae	Aristida	fendleriana	Fendler three-awn		X
Gramineae	Aristida	longiseta	Red three-awn		X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 6 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Gramineae	Beckmannia	syzigachne	Sloughgrass		X
Gramineae	Bouteloua	curtipendula	Side-oats grama		X
Gramineae	Bouteloua	gracilis	Blue grama		X
Gramineae	Bromus	inermis	Smooth brome		X
Gramineae	Bromus	japonicus	Japanese brome		X
Gramineae	Bromus	rectorum	Cheatgrass		X
Gramineae	Buchloe	dactyloides	Buffalo grass		X
Gramineae	Calamovilfa	longifolia	Prairie sandreed		X
Gramineae	Cenchrus	longispinus	Sand bur		X
Gramineae	Chloris	virgata	Windmill grass		X
Gramineae	Cynodon	dactylon	Bermuda grass		X
Gramineae	Distichlis	spicata	Alkali saltgrass		X
Gramineae	Echinochloa	crus-galli	Barneyard grass		X
Gramineae	Elymus	canadensis	Canadian wild rye		X
Gramineae	Eragrostis	ciliatensis	Stinkgrass		X
Gramineae	Eragrostis	diffusa	Spreading Love-grass		X
Gramineae	Festuca	pratensis	Meadow fescue		X
Gramineae	Hordeum	jubatum	Foxtail barley		X
Gramineae	Hordeum	pusillum	Little barley		X
Gramineae	Leersia	oryzoides	Rice Cut-grass		X
Gramineae	Lolium	multiflorum	Italian rye-grass		X
Gramineae	Monarda	squarrosa	False buffalo grass		X
Gramineae	Muhlenbergia	asperifolia	Alkali muhly		X
Gramineae	Muhlenbergia	racemosa	Marsh muhly		X
Gramineae	Muhlenbergia	torreyi	Ring muhly		X
Gramineae	Oryzopsis	hymenoides	Indian ricegrass		X
Gramineae	Panicum	capillare	Witchgrass		X
Gramineae	Panicum	virgatum	Switchgrass		X
Gramineae	Phalaris	arundinacea	Reed canarygrass		X
Gramineae	Phleum	pratense	Timothy		X
Gramineae	Poa	agassizensis	Mountain bluegrass		X
Gramineae	Poa	pratensis	Kentucky bluegrass		X
Gramineae	Poa	sandbergii	Sandberg Bluegrass		X
Gramineae	Polypogon	monspeliensis	Rabbitfoot grass		X
Gramineae	Tuccinellia	nuttalliana	Alkali grass		X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 7 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Gramineae	Schedonnardus	paniculatus	Tumble grass		X
Gramineae	Secale	cereale	Rye		X
Gramineae	Setaria	viridis	Green foxtail		X
Gramineae	Situnion	longifolium	Squirrel tail		X
Gramineae	Sorghastrum	avenaceum	Indian-grass		X
Gramineae	Spartina	pectinata	Prairie cordgrass		X
Gramineae	Sphaeropholis	obtusata	Prairie wedge-grass		X
Gramineae	Sporobolus	airoides	Alkali sacaton		X
Gramineae	Sporobolus	cryptandrus	Sand dropseed		X
Gramineae	Stipa	comata	Needle and thread		X
Gramineae	Stipa	viridula	Green needle grass		X
Gramineae	Vulpia	octoflora	Six-weeks fescue		X
Gramineae	Zea	mays	Corn		X
Haloragaceae	Myriophyllum	exalbescent	Water-molfoil		X
Hypericaceae	Hypericum	perforatum	Klamath weed, St. Johnswort		X
Juncaceae	Juncus	arcticus	Creeping rush		X
Juncaceae	Juncus	bufonius	Toad Rush		X
Juncaceae	Juncus	marginatus	Rush		X
Juncaceae	Juncus	interior	Rush		X
Juncaceae	Juncus	torreyi	Rush		X
Labiatae	Hedeoma	hispidum	False pennyroyal		X
Labiatae	Lycium	hallimifolium	Water horehound		X
Labiatae	Lycopus	americanus	Water horehound		X
Labiatae	Mentha	arvensis	Field mint		X
Labiatae	Monarda	spicata	Spearmint		X
Labiatae	Monarda	pectinata	Horse mint		X
Labiatae	Nepeta	cataria	Catnip		X
Labiatae	Salvia	reflexa	Salvia		X
Labiatae	Scutellaria	galericulata	Marsh skullcap		X
Labiatae	Stachys	palustris	Hedgenettle		X
Labiatae	Teucrium	canadense	Germander		X
Leguminosae	Astragalus	bisulcatus	Two-grooved milk-vetch		X
Leguminosae	Astragalus	caramicus	Potshard milk-vetch		X
Leguminosae	Astragalus	crassicaupus	Ground plum		X
Leguminosae	Astragalus	dasyglottis	Purple milk-vetch		X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on
Rocky Mountain Arsenal (Page 8 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Leguminosae	Astragalus	loriflorus	Lotus milk-vetch		X
Leguminosae	Astragalus	missouriensis	Missouri milk-vetch		X
Leguminosae	Catalpa	speciosa	Catalpa		X
Leguminosae	Dalea	aurea	Prairie clover		X
Leguminosae	Gleditsia	triacanthos	Honey locust		X
Leguminosae	Glycyrrhiza	lepidota	Wild licorice		X
Leguminosae	Lupinus	argenteus	Lupine		X
Leguminosae	Lupinus	plattensis	Lupine		X
Leguminosae	Medicago	saliva	Alfalfa		X
Leguminosae	Medicago	alba	White sweet clover		X
Leguminosae	Medicago	officinalis	Yellow sweet clover		X
Leguminosae	Oxytropis	lambertii	Colorado locoweed		X
Leguminosae	Fatalostemon	corpaticus	Compact prairie clover		X
Leguminosae	Psoralea	lanceolata	Narrowleaf scurf-pea		X
Leguminosae	Psoralea	tenuiflora	Slender scurf-pea		X
Leguminosae	Robinia	naomexicana	New Mexico locust		X
Leguminosae	Robinia	pseudacacia	Black locust		X
Leguminosae	Sophora	nuttalliana	Sophora		X
Leguminosae	Vicia	villosa	Vetch		X
Leguminosae	Lemna	minor	Duckweed		X
Leguminosae	Spirodela	polyrhiza	Duckweed		X
Leguminosae	Leucocrocinum	montanum	Sand lily		X
Liliaceae	Smilacina	racemosa	False Solomon's seal		X
Liliaceae	Yucca	glauca	Spanish bayonet		X
Liliaceae	Zygadenus	venenosus	Death camas		X
Loasaceae	Mentzelia	nuda	Evening star		X
Malvaceae	Malva	neglecta	Cheeseweed		X
Malvaceae	Sphaeralcea	coccinea	Scarlet globemallow		X
Malvaceae	Najas	quadralupensis	Water-nymph		X
Nyctaginaceae	Oxybaphus	linearis	Narrowleaf umbrella wort		X
Nyctaginaceae	Oxybaphus	nyctagineus	Umbrella wort		X
Oleaceae	Fraxinus	pennsylvanica	Green ash		X
Oleaceae	Syringa	vulgaris	Common lilac		X
Onagraceae	Calylophus	serrulata	Serrate evening primrose		X
Onagraceae	Epilobium	adenocaulon	Willow-herb		X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 9 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Onagraceae	Epilobium	glandulosum	Northern willow-herb		X
Onagraceae	Epilobium	paniculatum	Willow herb		X
Onagraceae	Gaura	coccinea	Scarlet gaura		X
Onagraceae	Gaura	parviflora	Tall gaura		X
Onagraceae	Gayophytum	ramosissimum	Ground smoke		X
Onagraceae	Oenothera	albicaulis	White-throated primrose		X
Onagraceae	Oenothera	caespitosa	Stemless primrose		X
Onagraceae	Oenothera	coronopifolia	Cut-leaf primrose		X
Onagraceae	Oenothera	nuttallii	Nuttall's primrose		X
Onagraceae	Oenothera	strigosa	Yellow primrose		X
Onagraceae	Gaura	neomexicana	Tall gaura		X
Papaveraceae	Argemone	polyanthemos	Prickly poppy		X
Pinaceae	Juniperus	scopulorum	Rocky Mountain juniper		X
Pinaceae	Picea	pungens	Colorado blue spruce		X
Pinaceae	Pinus	nigra	Austrian black pine		X
Pinaceae	Pinus	ponderosa	Ponderosa pine		X
Pinaceae	Pinus	sylvestris	Scotch pine		X
Pinaceae	Pinus	menziesii	Douglas fir		X
Pinaceae	Pseudotsuga	patagonica	Woolly plantain		X
Plantaginaceae	Plantago	laxiflora	Loose-flowered gilia		X
Polemoniaceae	Ipomopsis	pungens	Prickly gilia		X
Polemoniaceae	Leptodactylon	annuum	Tall eriogonum		X
Polygonaceae	Eriogonum	effusum	Bushy eriogonum		X
Polygonaceae	Fallopia	convolvulus	Black bindweed		X
Polygonaceae	Persicaria	malculata	Lady's thumb		X
Polygonaceae	Persicaria	amphibla	Water smartweed		X
Polygonaceae	Persicaria	lapathifolia	Smartweed		X
Polygonaceae	Persicaria	coccinea	Scarlet smartweed		X
Polygonaceae	Persicaria	pennsylvanica	Smartweed		X
Polygonaceae	Polygonum	aviculare	Devil's shoestring		X
Polygonaceae	Polygonum	ramosissimum	Bushy knotweed		X
Polygonaceae	Rumex	crispus	Curly dock		X
Polygonaceae	Rumex	salicifolius	Willowleaf dock		X
Polygonaceae	Rumex	venosus	Veiny dock		X
Portulacaceae	Portulaca	oleracea	Common purslane		X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 10 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Potamogetonaceae	Potamogeton	nodosus	Pondweed		X
Potamogetonaceae	Potamogeton	pusillus	Pondweed		X
Potamogetonaceae	Potamogeton	pectinatus	Pondweed		X
Potamogetonaceae	Potamogeton	gramineus	Pondweed		X
Primulaceae	Lysimachia	ciliata	Fringed loosestrife		X
Ranunculaceae	Clematis	ligusticifolia	Western virgin's bower		X
Ranunculaceae	Delphinium	virscens	Larkspur		X
Ranunculaceae	Myosurus	minimus	Mousetail		X
Ranunculaceae	Ranunculus	trichophyllus	Water crowfoot		X
Ranunculaceae	Ranunculus	macounii	Macoun's buttercup		X
Rosaceae	Potentilla	norvegica	Cinquefoil		X
Rosaceae	Potentilla	paradoxa	Cinquefoil		X
Rosaceae	Prunus	americana	Wild plum		X
Rosaceae	Prunus	virginiana	Choke cherry		X
Rosaceae	Pyrus	malus	Apple		X
Rosaceae	Rosa	arkansana	Prairie rose		X
Rosaceae	Rosa	woodsii	Wood's rose		X
Ruppiaceae	Ruppia	maritima	Wigeon-weed		X
Salicaceae	Populus	alba	White poplar		X
Salicaceae	Populus	deltoidea	Plains cottonwood		X
Salicaceae	Salix	amygdaloides	Peach-leaved willow		X
Salicaceae	Salix	exigua	Sandbar willow		X
Salicaceae	Salix	interior	Sandbar willow		X
Salicaceae	Salix	alba var.	Golden osler		X
Salicaceae	Salix	vetulina			
Santalaceae	Comandra	umbellata	Bastard toadflax		X
Saururaceae	Anemopsis	californica	Yerba Mansa		X
Saxifragaceae	Ribes	aureum	Golden currant		X
Scrophulariaceae	Limosella	aquatica	Mudwort		X
Scrophulariaceae	Penstemon	albidus	White penstemon		X
Scrophulariaceae	Penstemon	angustifolius	Narrow-leaf penstemon		X
Scrophulariaceae	Verbascum	thapsus	Great mullein		X
Scrophulariaceae	Veronica	americana	American brooklime		X
Scrophulariaceae	Veronica	anagallis	Water speedwell		X
Solanaceae	Lycium	halimifolium	Matrimony bush		X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 11 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Solanaceae	Physalis	bederaefolia	Ground cherry		X
Solanaceae	Physalis	heterophylla	Ground cherry		X
Solanaceae	Physalis	virginiana	Ground cherry		X
Solanaceae	Solanum	rostratum	Buffalo-bur		X
Solanaceae	Solanum	triflorum	Cut-leaf nightshade		X
Tamaricaceae	Tamarix	penlandra	Tamarisk		X
Tiliaceae	Tilia	americana	American linden		X
Typhaceae	Typha	angustifolia	Narrow-leaf cattail		X
Typhaceae	Typha	latifolia	Broad-leaf cattail		X
Ulmaceae	Celtis	reticulata	Hackberry		X
Ulmaceae	Ulmus	americana	American elm		X
Ulmaceae	Ulmus	parvifolia	Chinese elm		X
Umbelliferae	Sarula	erecta	Water parsnip		X
Umbelliferae	Conium	maculatum	Poison hemlock		X
Umbelliferae	Cymopterus	montanus	Biscuit root		X
Umbelliferae	Lomatium	orientale	Biscuit root		X
Urticaceae	Urtica	dioica	Stinging nettle		X
Verbenaceae	Abronia	fragrans	Prairie snowball		X
Verbenaceae	Phyla	cuneifolia	Fog fruit		X
Verbenaceae	Verbena	bracteata	Bracted verbena		X
Violaceae	Viola	nuttallii	Nuttall's violet		X
Vitaceae	Parthenocissus	inertia	Virginia creeper		X
Zannebelliaceae	Zannebellia	palustris	Horned pondweed		X
Zygophyllaceae	Tribulus	terrestris	Puncture vine		X
Ameluridae	Amelurus	kansae	Plains killifish		X
Ameluridae	Amelurus	sciadicus	Plains top minnow		X
Ameluridae	Amelurus	melas	Black bullhead		X
Ameluridae	Amelurus	punctatus	Channel catfish	I	X
Catostomidae	Catostomus	catostomus	Longnose sucker		X
Catostomidae	Catostomus	commersoni	White sucker		X
Centrarchidae	Lepomis	cyanellus	Green sunfish		X
Centrarchidae	Lepomis	gibbosus	Pumpkin seed		X

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Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 12 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Centrarchidae	Lepomis	macrochirus	Northern bluegill		X
Centrarchidae	Lepomis	microlophys	Red-ear sunfish		X
Centrarchidae	Micropterus	salmoides	Largemouth bass	G	X
Centrarchidae	Pomoxis	nilgromaculatus	Black crappie		X
Cyprinidae	Camposoma	anomalum	Plains stoneroller		
Cyprinidae	Cyprinus	carpio	Carp		X
Cyprinidae	Hybrogomathus	placita	Plains minnow		
Cyprinidae	Notropis	cornutus	Common shiner		
Cyprinidae	Notropis	deliciousus	Plains sand shiner		
Cyprinidae	Notropis	dorsalis	Bigmouth shiner		
Cyprinidae	Notropis	lutensis	Plains red shiner		
Cyprinidae	Notropis	notatus	Bluntnose minnow		X
Cyprinidae	Pimephales	promelas	Fathead minnow		X
Cyprinidae	Pimephales	rhinichthys	Longnose dace		
Cyprinidae	Semotilus	atromaculatus	Northern creek chub		
Esocidae	Esox	lucius	Northern pike	I	X
Percidae	Perca	flavescens	Yellow perch		X
Salmonidae	Salmo	gairdneri	Rainbow trout	I	X
REPTILES					
Chelydridae	Chelydra	serpentina	Snapping turtle	b	
Colubridae	Coluber	constrictor	Racer	B	X
Colubridae	Heterodon	nasicus	Western hognose snake	B	X
Colubridae	Lampropeltis	triangulum	Milk snake	B	
Colubridae	Masticophis	flagellum	Coachwhip	B	
Colubridae	Nerodia	slipson	Northern water snake	B	
Colubridae	Ophedrys	vernalis	Smooth green snake	B	
Colubridae	Pituophis	melanoleucus	Bullsnake	B	X
Colubridae	Thamnophis	elegans	Western Terrestrial garter	B	
Colubridae	Thamnophis	radix	Plains garter snake	B	X
Colubridae	Thamnophis	sirtalis	Common garter snake	B	X
Colubridae	Tropidoclonion	lineatum	Lined snake	B	
Emydidae	Chrysemys	picta	Western Painted turtle	B	

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 13 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Emyidae	Terrapene	ornata	Western box turtle	B	
Iguanidae	Holbrookia	maculata	Lesser earless lizard	B	X
Iguanidae	Phrynosoma	douglasii	Short-horned lizard	B	X
Iguanidae	Sceloporus	undulatus eryt.	Eastern fence lizard	B	
Iguanidae	Sceloporus	undulatus garm.	Northern fence lizard	B	
Scincidae	Eumeces	multivirgatus	Many-lined skink	B	X
Scincidae	Eumeces	obsoletus	Great Plains skink	B	
Telidae	Gnemidophorus	sexlineatus	Six-lined racerunner	B	
Trionychidae	Trionyx	spiniiferus	SpinySoft-shelled turtle	b	
Viperidae	Crotalus	viridis	Prairie rattlesnake	B	X
AMPHIBIANS					
Ambystomatidae	Ambystoma	liggnum	Tiger salamander	B	X
Bufo	Bufo	cognatus	Great Plains toad	B	X
Bufo	Bufo	woodhousei	Woodhouse's toad	B	X
Hylidae	Pseudacris	triseriata	Chorus frog	B	X
Pelobatidae	Scaphiopus	bombifrons	Plains spadefoot	B	X
Ranidae	Rana	catesbeiana	Bullfrog	B	X
Ranidae	Rana	piptans	Northern leopard frog	B	X
MAMMALS					
Antilocapridae	Antilocapra	americana	Pronghorn	B	
Canidae	Canis	latrans	Coyote	B	X
Canidae	Urocyon	cinereoargenteus	Gray fox	B	X
Canidae	Vulpes	velox	Swift fox	B	
Canidae	Vulpes	vulpes	Red fox	B	X
Castoridae	Castor	canadensis	Beaver	B	
Cervidae	Odocoileus	hemionus	Mule deer	B	
Cervidae	Odocoileus	virginianus	White-tailed deer	B	X
Cricetidae	Microtus	ochrogaster	Prairie vole	B	X
Cricetidae	Microtus	pennsylvanicus	Meadow vole	B	X
Cricetidae	Ondatra	zibethicus	Muskrat	B	X
Cricetidae	Onychomys	leucogaster	Northern grasshopper	B	X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 14 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Cricetidae	Peromyscus	maniculatus	mouse	B	X
Cricetidae	Reithrodontomys	megalotis	Deer mouse	B	X
Cricetidae	Reithrodontomys	montanus	Western harvest mouse	B	X
Didelphidae	Didelphis	virginiana	Plains harvest mouse	B	X
Erethizontidae	Erethizon	dorsatus	Opossum	B	
Felidae	Lynx	rufus	Porcupine	B	
Geomyidae	Geomys	bursarius	Bobcat	B	
Geomyidae	Thomomys	talpoides	Plains pocket gopher	B	X
Heteromyidae	Dipodomys	ordii	Northern pocket gopher	B	
Heteromyidae	Perognathus	fasciatus	Ord's kangaroo rat	B	X
			Olive-backed pocket mouse	B	X
Heteromyidae	Perognathus	flavescens	Plains pocket mouse	B	
Heteromyidae	Perognathus	flavus	Silky pocket mouse	B	X
Heteromyidae	Perognathus	hispidus	Hispid pocket mouse	B	X
Leporidae	Lepus	californicus	Black-tailed jackrabbit	B	X
Leporidae	Lepus	townsendii	White-tailed jackrabbit	B	X
Leporidae	Sylvilagus	auduboni	Desert cottontail	B	X
Leporidae	Sylvilagus	floridanus	Eastern cottontail	B	X
Muridae	Mus	musculus	House mouse	B, I	X
Muridae	Rattus	norvegicus	Norway rat	B, I	X
Mustelidae	Mephitis	mephitis	Striped skunk	B	X
Mustelidae	Mustela	erminea	Short-tailed weasel		
Mustelidae	Mustela	erminata	Long-tailed weasel	B	X
Mustelidae	Mustela	nigripes	Black-footed ferret	E	
Mustelidae	Mustela	vison	Mink	b	
Mustelidae	Spilogale	putorius	Spotted skunk	B	
Mustelidae	Taxidea	taxus	Badger	b	
Procyonidae	Procyon	lotor	Raccoon	B	X
Scuriidae	Cynomys	ludovicianus	Black-tailed prairie dog	B	X
Scuriidae	Eutamias	minimus	Least chipmunk	B	
Scuriidae	Sclurus	niger	Fox squirrel	B	X
Scuriidae	Spermophilus	spilosoma	Spotted ground squirrel	B	
Scuriidae	Spermophilus	tridecemlineatus	13-lined	B	X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 15 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Sciuridae	Spermophilus	variegatus	ground squirrel	B	X
Soricidae	Cryptotis	parva	Rock squirrel	B	
Soricidae	Sorex	cinereus	Least shrew	B	
Soricidae	Sorex	merriami	Masked shrew	B	
Vespertilionidae	Eptesicus	fuscus	Merriam's shrew	B	
Vespertilionidae	Lasionycteris	noctivagus	Big brown bat		
Vespertilionidae	Myotis	lucifugus	Silver-haired bat		
Vespertilionidae	Myotis	subulatus	Little brown myotis		
Vespertilionidae	Myotis	bornealis	Small-footed myotis		
Vespertilionidae	Nycterus	cinerea	Red bat		
Vespertilionidae	Nycterus	cinerea	Hoary bat		
Zapodidae	Zapus	hudsonius	Meadow jumping mouse	B	
BIRDS					
Accipitridae	Accipiter	cooperii	Cooper's hawk	B	X
Accipitridae	Accipiter	gentilis	Northern goshawk	B	X
Accipitridae	Accipiter	striatus	Sharp-shinned hawk	B	X
Accipitridae	Aquila	chrysaetos	Golden eagle	R	X
Accipitridae	Buteo	jamaicensis	Red-tailed hawk	R	X
Accipitridae	Buteo	lineatus	Rough-legged hawk	W	X
Accipitridae	Buteo	lineatus	Red-shouldered hawk	M	
Accipitridae	Buteo	platypterus	Broad-winged hawk	M	
Accipitridae	Buteo	regalis	Ferruginous hawk	R	X
Accipitridae	Buteo	swainsoni	Swainson's hawk	B	X
Accipitridae	Circus	cyaneus	Northern Harrier	R	X
Accipitridae	Haliaeetus	leucocephalus	Bald eagle	W,E	X
Aegithalidae	Psaltiriparus	minimus	Bushtit		
Alaudidae	Eremophila	alpestris	Horned lark	R	X
Alcedinidae	Ceryle	alcyon	Belted kingfisher	R	
Alcidae	Synthliboramphus	antiquus	Ancient murrelet		
Anatidae	Alx	sponsa	Wood duck	R	X
Anatidae	Anas	acuta	Northern Pintail	R	X
Anatidae	Anas	americana	American wigeon	R	X
Anatidae	Anas	clypeata	Northern shoveler	R	X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 16 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Anatidae	Anas	crecca	Green-winged teal	R	X
Anatidae	Anas	cyanoptera	Cinnamon teal	B	X
Anatidae	Anas	diazii	Mexican duck		
Anatidae	Anas	discors	Blue-winged teal	B	X
Anatidae	Anas	fulvigula	Mottled duck		
Anatidae	Anas	platyrhynchos	Mallard	R	X
Anatidae	Anas	rubripes	American Black duck	M	
Anatidae	Anas	strepera	Gadwall	R	X
Anatidae	Anser	albifrons	Greater White-fronted goose	M	
Anatidae	Aythya	affinis	Lesser scaup	W	X
Anatidae	Aythya	americana	Redhead	R	X
Anatidae	Aythya	collaris	Ring-necked duck	W	X
Anatidae	Aythya	marila	Greater scaup	M	
Anatidae	Aythya	valisineria	Canvasback	N	X
Anatidae	Branta	bernicla	Brant	M	
Anatidae	Branta	canadensis	Canada goose	R	X
Anatidae	Bucephala	albeola	Bufflehead	W	X
Anatidae	Bucephala	clangula	Common goldeneye	W	X
Anatidae	Bucephala	islandica	Barrows goldeneye	W	X
Anatidae	Chen	caerulescens	Snow goose	M	X
Anatidae	Chen	rossii	Ross's goose	N	
Anatidae	Clangula	hyemalis	Oldsquaw	M	
Anatidae	Cygnus	columbianus	Whistling swan		
Anatidae	Lophodytes	cucullatus	Hooded merganser	W	X
Anatidae	Melanitta	fusca	White-winged scoter	M	
Anatidae	Melanitta	nigra	Black scoter	M	
Anatidae	Melanitta	perspicillata	Surf scoter	M	
Anatidae	Mergus	merganser	Common merganser	W	
Anatidae	Mergus	separator	Red-breasted merganser	M	
Anatidae	Oxyura	jamaicensis	Ruddy duck	B	X
Anatidae	Somateria	mollissima	Common elder		
Anhinga	Anhinga	anhinga	Anhinga		
Apodidae	Chaetura	pelagica	Chimney swift	B	
Ardeidae	Ardea	herodias	Great blue heron	R	X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on
Rocky Mountain Arsenal (Page 17 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Ardeidae	Botaurus	lentiginosus	American bittern	b	
Ardeidae	Bubulcus	ibis	Cattle egret	n	
Ardeidae	Bulorides	siriatus	Green-backed heron	M	
Ardeidae	Casmerodius	albus	Great egret	n	
Ardeidae	Egretta	caerulea	Little blue heron	M	
Ardeidae	Egretta	thula	Snowy egret	B	
Ardeidae	Egretta	tricolor	Tri-colored heron	M	
Ardeidae	Ncyticorax	violaceus	Yellow crowned night heron	b	
Ardeidae	Ncyticorax	nycticorax	Black crowned night heron	B	X
Bombycillidae	Bombycilla	cedrorum	Cedar waxwing	W	X
Bombycillidae	Bombycilla	garrulus	Bohemian waxwing	W	
Caprimulgidae	Chordeiles	minor	Common nighthawk	B	X
Caprimulgidae	Phalaenoptilus	nuttalli	Common poorwill	B	
Cathartidae	Cathartes	aura	Turkey vulture	B	X
Charadriidae	Charadrius	alexandrinus	Snowy plover	M	
Charadriidae	Charadrius	melodus	Piping plover	E	
Charadriidae	Charadrius	montanus	Mountain plover	b	
Charadriidae	Charadrius	semipalmatus	Semipalmated plover	M	
Charadriidae	Charadrius	vociferus	Killdeer	R	X
Charadriidae	Pluvialis	dominica	American golden plover	M	
Charadriidae	Pluvialis	squatarola	Black-bellied plover	M	
Ciconiidae	Mycteria	americana	Wood stork	W	
Cinclidae	Cinclus	mexicanus	American dipper	B	
Columbidae	Columba	fasciata	Band-tailed pigeon	B	
Columbidae	Columba	livia	Rock dove	R	X
Columbidae	Zenaidura	macroura	Mourning dove	R	X
Corvidae	Corvus	brachyrhynchos	Common crow	R	X
Corvidae	Corvus	corax	Common raven	W	
Corvidae	Corvus	cryptoleucus	Chihuahuan raven	M	
Corvidae	Cyanocitta	cristata	Blue jay	R	
Corvidae	Gymnorhinus	cyanocephalus	Pinyon jay	M	
Corvidae	Nucifraga	columbiana	Clark's nutcracker	M	
Corvidae	Pica	pica	Black-billed magpie	R	X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 18 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Cuculidae	Coccyzus	americanus	Yellow-billed cuckoo	b	
Cuculidae	Coccyzus	erythrophthalmus	Black-billed cuckoo	b	
Emberizidae	Agelaius	phoeniceus	Red-winged blackbird	R	X
Emberizidae	Amphispiza	cassinii	Cassin's sparrow	b	X
Emberizidae	Amphispiza	ruficeps	Rufous-crown sparrow		
Emberizidae	Ammodramus	bairdii	Baird's sparrow	M	
Emberizidae	Ammodramus	lecontei	Le Conte's sparrow		
Emberizidae	Ammodramus	savannarum	Grasshopper sparrow	B	X
Emberizidae	Amphispiza	belli	Sage sparrow	M	
Emberizidae	Amphispiza	billineata	Black-throated sparrow	M	
Emberizidae	Calamospiza	melanocorys	Lark bunting	B	X
Emberizidae	Calcaricus	lapponicus	Lapland longspur	M	
Emberizidae	Calcaricus	mcgowani	McGowan's longspur	M	X
Emberizidae	Calcaricus	ornatus	Chestnut-sided longspur		
Emberizidae	Cardinalis	cardinalis	Northern cardinal	N	
Emberizidae	Chondestes	gramacus	Lark sparrow	B	X
Emberizidae	Dendroica	caerulescens	Black-throated Blue warbler	M	
Emberizidae	Dendroica	castanea	Bay-breasted warbler	B	
Emberizidae	Dendroica	cerulea	Cerulean warbler		
Emberizidae	Dendroica	coronata	Yellow-rumped warbler	M	X
Emberizidae	Dendroica	dominica	Yellowthroat warbler	M	
Emberizidae	Dendroica	fusca	Blackburnian warbler	M	X
Emberizidae	Dendroica	graciae	Grace's warbler		
Emberizidae	Dendroica	magnolia	Magnolia warbler	M	
Emberizidae	Dendroica	nigrascens	Black-throated gray warbler	M	
Emberizidae	Dendroica	palmarum	Palm warbler	M	
Emberizidae	Dendroica	pensylvanica	Chestnut-sided warbler	M	X
Emberizidae	Dendroica	petchnia	Yellow warbler	B	X
Emberizidae	Dendroica	pinus	Pine warbler		
Emberizidae	Dendroica	striata	Blackpoll warbler	M	X
Emberizidae	Dendroica	townsendi	Townsend's warbler	M	
Emberizidae	Dendroica	virens	Black-throated green warbler	M	

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on
Rocky Mountain Arsenal (Page 19 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Emberizidae	Dolichonyx	oryzivorus	Bobolink	B	X
Emberizidae	Euphagus	carolinus	Rusty blackbird	W	
Emberizidae	Euphagus	cyanocephalus	Brewer's blackbird	R	X
Emberizidae	Geothlypis	trichas	Common yellowthroat	B	X
Emberizidae	Guiraca	caerulea	Blue grosbeak	B	X
Emberizidae	Helminthos	vermivorus	Worm-eating warbler	M	
Emberizidae	Icteria	virens	Yellow-breasted chat	B	
Emberizidae	Icterus	galbula	Northern oriole	B	X
Emberizidae	Icterus	spurius	Orchard oriole	B	
Emberizidae	Junco	hyemalis	Dark-eyed junco	W	X
Emberizidae	Melospiza	georgiana	Swamp sparrow	W	
Emberizidae	Melospiza	lincolnii	Lincoln's sparrow	M	X
Emberizidae	Melospiza	melodia	Song sparrow	R	X
Emberizidae	Mniotilta	varia	Black & white warbler	M	X
Emberizidae	Molothrus	ater	Brown-headed cowbird	B	X
Emberizidae	Oporornis	tolmiei	MacGillivray warbler	M	X
Emberizidae	Parula	americana	Northern parula	M	X
Emberizidae	Passerculus	sandwichensis	Savannah Sparrow	B	X
Emberizidae	Passerella	iliaca	Fox sparrow	W	X
Emberizidae	Passerina	amoena	Lazuli bunting	B	
Emberizidae	Passerina	cirica	Painted bunting	M	
Emberizidae	Passerina	cyanea	Indigo bunting	B	X
Emberizidae	Pheucticus	ludovicianus	Rose-breasted grosbeak	M	X
Emberizidae	Pheucticus	melanocephalus	Blackheaded grosbeak	B	X
Emberizidae	Pipilo	chlorurus	Green-tailed towhee	b	
Emberizidae	Pipilo	erythrophthalmus	Rufous-sided towhee	B	X
Emberizidae	Pipilo	fuscus	Brown towhee		
Emberizidae	Piranga	ludoviciana	Western tanager	B	
Emberizidae	Piranga	olivacea	Scarlet tanager	M	
Emberizidae	Piranga	rubra	Summer tanager	M	
Emberizidae	Platyrhynchus	nivalis	Snow bunting	W	
Emberizidae	Poocetes	gramineus	Vesper sparrow	B	X
Emberizidae	Protonotaria	cirica	Prothonotary warbler	M	
Emberizidae	Quiscalus	quiscula	Common grackle	B	X
Emberizidae	Sialurus	auroparillus	Ovenbird	B	X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 20 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Emberizidae	Seturus	noveboracensis	Northern waterthrush	M	
Emberizidae	Setophaga	ruticilla	American redstart	B	X
Emberizidae	Spiza	americana	Dickcissel	B	X
Emberizidae	Spizella	arborea	American tree sparrow	W	X
Emberizidae	Spizella	breweri	Brewer's sparrow	B	X
Emberizidae	Spizella	pallida	Clay-colored sparrow	M	X
Emberizidae	Spizella	passerina	Chipping sparrow	B	X
Emberizidae	Spizella	pusilla	Field sparrow	M	
Emberizidae	Sturnella	neglecta	Western meadowlark	R	X
Emberizidae	Vermivora	celata	Orange-crown warbler	M	X
Emberizidae	Vermivora	chrysoptera	Golden-wing warbler	M	
Emberizidae	Vermivora	peregrina	Tennessee warbler	M	X
Emberizidae	Vermivora	pinus	Blue-winged warbler	M	
Emberizidae	Vermivora	ruficapilla	Nashville warbler	M	X
Emberizidae	Vermivora	virginiae	Virginia's warbler	B	
Emberizidae	Wilsonia	canadensis	Canada warbler	M	
Emberizidae	Wilsonia	clitina	Hooded warbler	M	X
Emberizidae	Wilsonia	pusilla	Wilson's warbler	M	X
Emberizidae	Xanthocephalus	xanthocephalus	Yellow-headed blackbird	B	X
Emberizidae	Zonotrichia	leucophrys	White-crowned sparrow	W	X
Emberizidae	Zonotrichia	querula	Harris's sparrow	W	
Falconidae	Falco	columbarius	Merlin	W	
Falconidae	Falco	mexicanus	Prairie falcon	R	X
Falconidae	Falco	peregrinus	Peregrine falcon	M X	
Falconidae	Falco	rusticolus	Gyr falcon	M	
Falconidae	Falco	sparverius	American kestrel	R	X
Falconidae	Carduelis	flammea	Common redpoll	W	
Falconidae	Carduelis	pinus	Pine siskin	R	X
Falconidae	Carduelis	psaltria	Lesser goldfinch	B	X
Falconidae	Carduelis	tristis	American goldfinch	R	X
Falconidae	Carpodacus	cassini	Cassin's finch	W	
Falconidae	Carpodacus	mexicanus	House finch	R	X
Falconidae	Carpodacus	purpureus	Purple finch	W	
Falconidae	Coccothraustes	vespertinus	Evening grosbeak	R	
Falconidae	Leucosticte	arctica	Rosy finch	W	

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 21 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Fringillidae	Leucosticte	atrata	Black rosy finch		
Fringillidae	Leucosticte	australis	Brown-cap rosy finch		
Fringillidae	Loxia	curvirostra	Red crossbill	R	
Fringillidae	Loxia	leucoptera	White-wing crossbill	W	
Fringillidae	Pinicola	enucleator	Pine grosbeak	W	
Gaviidae	Gavia	arctica	Arctic loon	M	
Gaviidae	Gavia	immer	Common loon	M	
Gaviidae	Gavia	stellata	Red-throated loon	M	
Gruidae	Grus	americana	Whooping crane	E	
Gruidae	Grus	canadensis	Sandhill crane	M	
Hirundinidae	Hirundo	pyrrhonota	Cliff swallow	B	X
Hirundinidae	Hirundo	rustica	Barn swallow	B	X
Hirundinidae	Riparia	cliparia	Bank swallow	B	
Hirundinidae	Stelgidopteryx	serripennis	Northern Rough-winged swallow	B	
Hirundinidae	Tachycineta	bicolor	Tree swallow	B	X
Hirundinidae	Tachycineta	thalassina	Violet-green swallow	M	X
Laniidae	Lanius	excubitor	Northern shrike	W	X
Laniidae	Lanius	ludovicianus	Loggerhead shrike	B	X
Laridae	Chlidonias	niger	Black tern	B	X
Laridae	Larus	argentatus	Herring gull	W	X
Laridae	Larus	atrifrons	Laughing gull	M	
Laridae	Larus	californicus	California gull	N	
Laridae	Larus	delawarensis	Ring-billed gull	N	
Laridae	Larus	glaucopterus	Iceland gull		X
Laridae	Larus	hyperboreus	Glaucous gull	W	
Laridae	Larus	marinus	Green black-backed gull	W	
Laridae	Larus	minutus	Little gull	M	
Laridae	Larus	philadelphia	Bonaparte's gull	M	
Laridae	Larus	pipixcan	Franklin's gull	M	
Laridae	Larus	thayeri	Thayer's gull	W	
Laridae	Pagophila	eburnea	Ivory gull		
Laridae	Rissa	tridactyla	Black legged kittiwake	M	
Laridae	Sterna	ankistrum	Least tern		
Laridae	Sterna	forsteri	Forster's tern	B	

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 22 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Laridae	Sterna	hirundo	Common tern	M	
Laridae	Sterna	paradisaea	Arctic tern		
Laridae	Xema	sabini	Sabine's gull	M	
Meleagrididae	Meleagris	gallopavo	Wild turkey	R	X
Mimidae	Dumetella	carolinensis	Gray catbird	B	X
Mimidae	Mimus	polyglottos	Northern mockingbird	R	X
Mimidae	Oreoscoptes	montanus	Sage thrasher	B	
Mimidae	Toxostoma	curvirostre	Curved-bill thrasher		
Mimidae	Toxostoma	rufum	Brown thrasher	B	X
Motacillidae	Anthus	spinoletta	Water pipit	M	X
Motacillidae	Anthus	spragueii	Sprague's pipit	M	
Muscicapidae	Catharus	fuscescens	Veery	B	
Muscicapidae	Catharus	minimus	Gray-cheeked thrush	M	
Muscicapidae	Catharus	ustulatus	Swainson's thrush	B	X
Muscicapidae	Myiocichla	mustelina	Wood thrush	M	
Muscicapidae	Myadestes	townsendii	Townsend's solitaire	W	X
Muscicapidae	Polioptila	caerulea	Bluegray gnatcatcher	M	
Muscicapidae	Regulus	calendula	Ruby-crowned kinglet	M	X
Muscicapidae	Regulus	satrapi	Golden-crown kinglet	W	
Muscicapidae	Sialia	currucoides	Mountain bluebird	B	X
Muscicapidae	Sialia	mexicana	Western bluebird	B	
Muscicapidae	Sialia	sialis	Eastern bluebird	M	
Muscicapidae	Turdus	migratorius	American robin	R	X
Pandionidae	Pandion	haliaetus	Osprey	M	X
Paridae	Parus	atricapillus	Black-capped chickadee	R	X
Paridae	Parus	gambeli	Mountain chickadee	W	
Passeridae	Passer	domesticus	House sparrow	R, I	X
Pe-ecanidae	Pelecanus	erythrorhynchos	American White pelican	n	X
Phalacrocoracidae	Phalacrocorax	auritus	Double-crowned cormorant	B	X
Phalacrocoracidae	Phalacrocorax	olivaceus	Olivaceous cormorant	M	
Phalaropodidae	Phalaropus	fulicaria	Red phalarope	M	
Phalaropodidae	Phalaropus	lobatus	Northern phalarope	M	
Phalaropodidae	Phalaropus	tricolor	Wilson's phalarope	B	X
Phasianidae	Alactoria	chukar	Chukar	N	X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 23 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Phasianidae	Callipepla	squamata	Scaled quail	b	
Phasianidae	Colinus	virginianus	Northern bobwhite	R	X
Phasianidae	Phasianus	colchicus	Ring-necked pheasant	R	X
Picidae	Colaptes	auratus	Northern flicker	R	X
Picidae	Melanerpes	carolinus	Red-belly woodpecker	M	
Picidae	Melanerpes	erythrocephalus	Red-headed woodpecker	B	X
Picidae	Melanerpes	lewis	Lewis's woodpecker	R	
Picidae	Picoides	pubescens	Downy woodpecker	R	X
Picidae	Picoides	villosus	Hairy woodpecker	R	
Picidae	Sphyrapicus	varius	Yellow-bellied sapsucker	N	
Podicipedidae	Aechmophorus	occidentalis	Western grebe	R	X
Podicipedidae	Podiceps	auritus	Horned grebe	M	
Podicipedidae	Podiceps	griseus	Red-necked grebe	M	
Podicipedidae	Podiceps	nigricollis	Eared grebe	b	X
Podicipedidae	Podilymbus	podiceps	Pied-billed grebe	R	X
Podicipedidae	Phalacrocorax	nileus	Phalacrocorax		
Podicipedidae	Podiceps	noveboracensis	Yellow rail		
Rallidae	Colinus	virginianus	American quail	R	X
Rallidae	Callinula	chloropus	Common gallinule		
Rallidae	Laterallus	jamaicensis	Black rail		
Rallidae	Porzana	carolinensis	Sora	B	X
Rallidae	Rallus	limicola	Virginia rail	R	X
Rallidae	Himantopus	mexicanus	Black-necked stilt	M	
Rallidae	Recurvirostra	americana	American avocet	B	X
Rallidae	Arenaria	interpres	Ruddy turnstone	M	
Rallidae	Bartramia	longicauda	Upland sandpiper	b	X
Rallidae	Callidris	alba	Sanderling	M	
Rallidae	Callidris	alpina	Dunlin	M	
Rallidae	Callidris	bairdii	Baird's sandpiper	M	
Rallidae	Callidris	canutus	Red knot	M	
Rallidae	Callidris	fuscicollis	White-rumped sandpiper	M	
Rallidae	Callidris	himantopus	Stilt sandpiper	M	X
Rallidae	Callidris	maui	Western sandpiper	M	X
Rallidae	Callidris	melanotos	Pectoral sandpiper	M	X
Rallidae	Callidris	minutilla	Least sandpiper	M	X

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 24 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Scolopacidae	Calidris	pusilla	Semipalm-sandpiper	M	
Scolopacidae	Catoptrophorus	semipalmatus	Willet	M	X
Scolopacidae	Gallinago	gallinago	Common snipe	R	X
Scolopacidae	Limnodromus	griseus	Short-billed dowitcher	M	
Scolopacidae	Limnodromus	scolopaceus	Long-billed dowitcher	M	X
Scolopacidae	Limosa	fedoa	Marbled godwit	M	
Scolopacidae	Limosa	haemastica	Hudsonian godwit	M	
Scolopacidae	Numenius	americanus	Long-billed curlew	M	
Scolopacidae	Numenius	phaeopus	Whimbrel	M	
Scolopacidae	Scolopax	minor	American woodcock	M	X
Scolopacidae	Tringa	flavipes	Lesser yellowlegs	M	X
Scolopacidae	Tringa	melanoleuca	Greater yellowlegs	M	X
Scolopacidae	Tringa	solitaria	Solitary sandpiper	M	X
Scolopacidae	Tryngites	subruficollis	Buffbreast sandpiper	M	
Sittidae	Carthya	americana	Brown creeper	R	X
Sittidae	Sitta	canadensis	Red-breasted nuthatch	R	X
Sittidae	Sitta	carolinensis	White-breasted nuthatch	R	X
Solopacidae	Actitis	macularia	Spotted sandpiper	B	X
Stercorariidae	Stercorarius	parasiticus	Parasitic jaeger	M	
Stercorariidae	Stercorarius	pomarinus	Pomarine jaeger	M	
Strigidae	Aegolius	acadicus	Northern Saw-whet owl	R	
Strigidae	Asio	flammeus	Short-eared owl	R	X
Strigidae	Asio	otus	Long-eared owl	R	X
Strigidae	Athene	cunicularia	Burrowing owl	B	X
Strigidae	Bubo	virginianus	Great horned owl	R	X
Strigidae	Glaucidium	gnoma	Pygmy owl	M	
Strigidae	Nyctea	scandiaca	Snowy owl	M	
Strigidae	Otus	asio	Eastern screech owl	R	
Strigidae	Otus	kennicottii	Western screech owl	R	
Strigidae	Strix	occidentalis	Spotted owl	M	
Sturnidae	Sturnus	vulgaris	Starling	R,I	X
Tetraonidae	Tympanuchus	phasianellus	Sharp-tailed grouse	R,E	
Threskiornithidae	Plegadis	chibi	White-faced ibis	M	X
Trochilidae	Archilochus	alexandri	Black-chinned hummingbird		
Trochilidae	Salasphorus	platycercus	Brown-tailed hummingbird	B	

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 25 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Trochilidae	Selasphorus	rufus	Rufous hummingbird	M	
Trochilidae	Stellula	calliope	Calliope hummingbird	B	
Troglodytidae	Cisticolus	palustris	Long-bill marsh wren		X
Troglodytidae	Salpinctes	obsoletus	Rock wren	b	
Troglodytidae	Thryothorus	ludovicianus	Carolina wren	M	
Troglodytidae	Troglodytes	aedon	House wren	B	X
Troglodytidae	Troglodytes	trogodytes	Winter wren	W	
Troglodytidae	Thryomanes	bewickii	Bewick's wren	W	
Tyrannidae	Contopus	borealis	Olive-sided flycatcher	M	
Tyrannidae	Contopus	sordidulus	Western wood pewee	B	
Tyrannidae	Contopus	virens	Eastern wood pewee		
Tyrannidae	Empidonax	alorum	Alder flycatcher		
Tyrannidae	Empidonax	difficilis	Western flycatcher	M	X
Tyrannidae	Empidonax	hammondi	Hammond's flycatcher	M	
Tyrannidae	Empidonax	minimus	Least flycatcher	M	
Tyrannidae	Empidonax	oberholseri	Dusky flycatcher	M	X
Tyrannidae	Empidonax	trillii	Willow flycatcher	M	X
Tyrannidae	Myiarchus	cinerascens	Ashthroa flycatcher	M	
Tyrannidae	Myiarchus	crinitus	Green-crested flycatcher	M	
Tyrannidae	Pyrocephalus	rubinus	Vermillion flycatcher	M	
Tyrannidae	Sayornis	phoebe	Eastern phoebe	M	
Tyrannidae	Sayornis	saya	Say's phoebe	B	X
Tyrannidae	Tyrannus	forficatus	Scissortail flycatcher	M	
Tyrannidae	Tyrannus	tyrannus	Eastern kingbird	B	X
Tyrannidae	Tyrannus	verticalis	Western kingbird	B	X
Tyrannidae	Tyrannus	vociferans	Cassin's kingbird	b	

Table A-1. Plants and Animals Species Which Inhabit or Potentially Occur on Rocky Mountain Arsenal (Page 26 of 26)

FAMILY	GENUS	SPECIES	COMMON NAME	STATUS*	OBSERVED ON RMA
Tyrtonidae	Tyto	alba	Common barn owl	R	X
Vireonidae	Vireo	bellii	Bell's vireo		
Vireonidae	Vireo	flavifrons	Yellow-throated vireo		
Vireonidae	Vireo	gilvus	Warbling vireo	B	X
Vireonidae	Vireo	olivaceus	Red-eyed vireo	B	X
Vireonidae	Vireo	philadelphicus	Philadelphia vireo	M	
Vireonidae	Vireo	solitarius	Solitary vireo	B	X

* Status: B=Definite breeder b=Likely breeder E=Endangered
C=Came I=Introduced M=Migrant
n=Non-breeder R=Resident W=Winter visitor

References: see APPENDIX A, REFERENCES

Source: ESE, 1988.

APPENDIX B
STATISTICAL ANALYSES

APPENDIX B
TABLE OF CONTENTS

Section	Page
1.0 STATISTICAL ANALYSES FOR CURRENT EXTENT OF CONTAMINATION IN BIOTA	B-5
1.1 INTRODUCTION	B-5
1.2 EARTHWORMS	B-5
1.3 GRASSHOPPERS	B-8
1.4 MALLARDS	B-8
1.5 PHEASANTS	B-11
1.6 COTTONTAIL RABBITS	B-14
1.7 DEER	B-14
1.8 PRAIRIE DOGS	B-19
1.9 AMERICAN KESTREL	B-19
2.0 STATISTICAL ANALYSES FOR CONTAMINATION EFFECTS	B-27
2.1 INTRODUCTION	B-27
2.2 SNAILS	B-27
2.3 GRASSHOPPER DENSITY	B-33
2.4 EARTHWORM DENSITY	B-34
2.5 ACETYLCHOLINESTERASE (ACHE) ACTIVITY	B-38
2.5.1 PRAIRIE DOGS	B-38
2.5.2 COTTONTAIL RABBITS	B-40
2.5.3 MALLARDS	B-40
2.5.4 PHEASANTS	B-42
2.6 PRAIRIE DOG DENSITY	B-42
2.7 AMERICAN KESTREL STUDY	B-45
3.0 STATISTICAL ANALYSES FOR AQUATIC CONTAMINANTS	B-48
3.1 RATIONALE	B-48
3.2 RESULTS AND DISCUSSION	B-48
3.2.1 DATA FROM 1986 AQUATIC STUDIES	B-63
3.2.2 DATA FROM 1988 AQUATIC STUDIES	B-63
3.3 CONCLUSIONS	B-68
REFERENCES	B-69

LIST OF FIGURES

Figure		Page
B.1-1	Statistical Analyses of Contaminants in Earthworms	B-6
B.1-2	Statistical Analyses of Contaminants in Grasshoppers	B-9
B.1-3	Statistical Analyses of Contaminants in Mallards	B-12
B.1-4	Statistical Analyses of Contaminants in Ring-Necked Pheasants	B-15
B.1-5	Statistical Analyses of Contaminants in Cottontail Rabbits	B-18
B.1-6	Statistical Analyses of Contaminants in Black-Tailed Prairie Dogs	B-21
B.1-7	Statistical Analyses of Contaminants in American Kestrel	B-25

LIST OF TABLES

Table		Page
B.1-1	Statistical Analyses of Contamination in Mule Deer	B-20
B.2-1	Statistical Results of Parametric and Non-Parametric Analyses for Snail Density, 1986	B-29
B.2-2	Statistical Results of Parametric and Non-Parametric Analyses for Snail Density, 1987	B-30
B.2-3	Statistical Results of Parametric and Non-Parametric Analyses for Total Snail Weight, 1986	B-31
B.2-4	Statistical Results of Parametric and Non-Parametric Analyses for Total Snail Weight, 1987	B-32
B.2-5	Statistical Analysis of Grasshopper Density	B-35
B.2-6	Multiple Regression Analysis of Grasshopper Density and Analysis of Residuals from the Multiple Regression Analysis	B-36
B.2-7	Statistical Analysis of Earthworm Density	B-37
B.2-8	Statistical Analysis of AChE Activity in Prairie Dogs	B-39
B.2-9	Statistical Analysis of AChE Activity in Cottontail Rabbits	B-41
B.2-10	Statistical Analysis of AChE Activity in Mallards	B-43
B.2-11	Statistical Analysis of AChE Activity in Pheasants	B-44
B.2-12	Statistical Analysis of Prairie Dog Density	B-46
B.2-13	Statistical Analysis of American Kestrel Nesting Success	B-47
B.3-1	Descriptive Statistics (mean, standard error, and sample size) for analytes (A, mercury; B, dieldrin; and C, DDE) involved in previous statistical analyses (Tables 1 through 6).	B-49
B.3-2	Results of one-way (Lake Derby versus Ladora) parametric and nonparametric (Kruskal-Wallis one-way analysis of variance by ranks = KW) ANOVA on analytes (A, mercury; and B, dieldrin) for pike filets in 1986.	B-52
B.3-3	Results of one-way (bluegill versus largemouth bass) parametric and nonparametric (Kruskal-Wallis one-way analysis of variance by ranks = KW) ANOVA on analytes (A, mercury; and B, dieldrin) for Lake Mary filets in 1986.	B-53

Table		Page
B.3-4	Results of one-way (remains versus fillets) parametric and nonparametric (Kruskal-Wallis one-way analysis of variance by ranks = KW) ANOVA on analytes (A, mercury; B, dieldrin; and C, DDE) for bluegill from Lake McKay in 1988.	B-54
B.3-5	Results of two-way (lakes--Derby versus Ladora versus Mary; species--largemouth bass versus bluegill) parametric ANOVA (including a priori tests) and hierarchical nonparametric Kruskal-Wallis one-way ANOVA by ranks (KW) on analytes (A, mercury; and B, dieldrin) for whole tissue samples in 1986.	B-55
B.3-6	Results of one-way (lakes--Derby versus McKay; tissues--remains versus fillets) parametric ANOVA and hierarchical nonparametric Kruskal-Wallis one-way ANOVA by ranks (KW) on analytes (A, mercury; B, dieldrin; C, DDE; and D, aldrin) for largemouth bass in 1988.	B-56
B.3-7	Results of two-way (lakes--Derby versus McKay; species--largemouth bass versus bluegill) parametric ANOVA (including a priori tests) and hierarchical nonparametric Kruskal-Wallis one-way ANOVA by ranks (KW) on mercury for whole tissue samples in 1988. Results of one-way (Lake Derby versus Lake McKay) parametric and nonparametric (Kruskal-Wallis one-way ANOVA by ranks = KW) ANOVA on dieldrin and DDE for whole tissues in 1988.	B-58
B.3-8	Statistical comparisons of species, lakes, and tissues. Tests are two-way ANOVAs and nonparametric Kruskal-Wallis.	B-59
B.3-9	Statistical comparisons among lakes. Test are parametric ANOVA, t-tests, and nonparametric Kruskal-Wallis.	B-60
B.3-10	Statistical comparisons among species. Test are parametric t-tests and nonparametric Kruskal-Wallis.	B-61
B.3-11	Statistical comparisons among tissue types. Test are parametric t-tests and nonparametric Kruskal-Wallis.	B-62
B.3-12	Nonsignificant comparisons among RMA lakes. Tests are parametric ANOVA.	B-64
B.3-13	Nonsignificant comparisons among species. Tests are parametric ANOVA.	B-65
B.3-14	Nonsignificant comparisons among tissue types. Tests are parametric ANOVA.	B-66

1.0 STATISTICAL ANALYSES FOR CURRENT EXTENT OF CONTAMINATION IN BIOTA

1.1 INTRODUCTION

Nonparametric statistical methods were used for all analyses of tissue concentration data because variances were consistently heteroscedastic and markedly non-normal. The general analytical approach for each species was the same in that a separate Kruskal-Wallis one-way ANOVA by ranks (Siegel, 1957) for each dependent variable (i.e., arsenic, mercury, aldrin, dieldrin, endrin, DDE, and DDT) initially was used to evaluate if at least one treatment group differed from the others. This preliminary analysis was then followed by a set of hierarchical or orthogonal a priori contrasts that were specific for the particular experimental design or species of concern. The experimental design for each species is illustrated by a dendrogram in which compared groups (vertical lines) are united by a horizontal bar. The results of the statistical analysis for each variable are then superimposed on a dendrogram along with descriptive statistics (mean, standard error of the mean, and sample size) for each treatment group. Samples sizes were insufficient for statistical comparisons involving sunflowers or morning glories. Means were calculated substituting zero (0) for levels below detection limits.

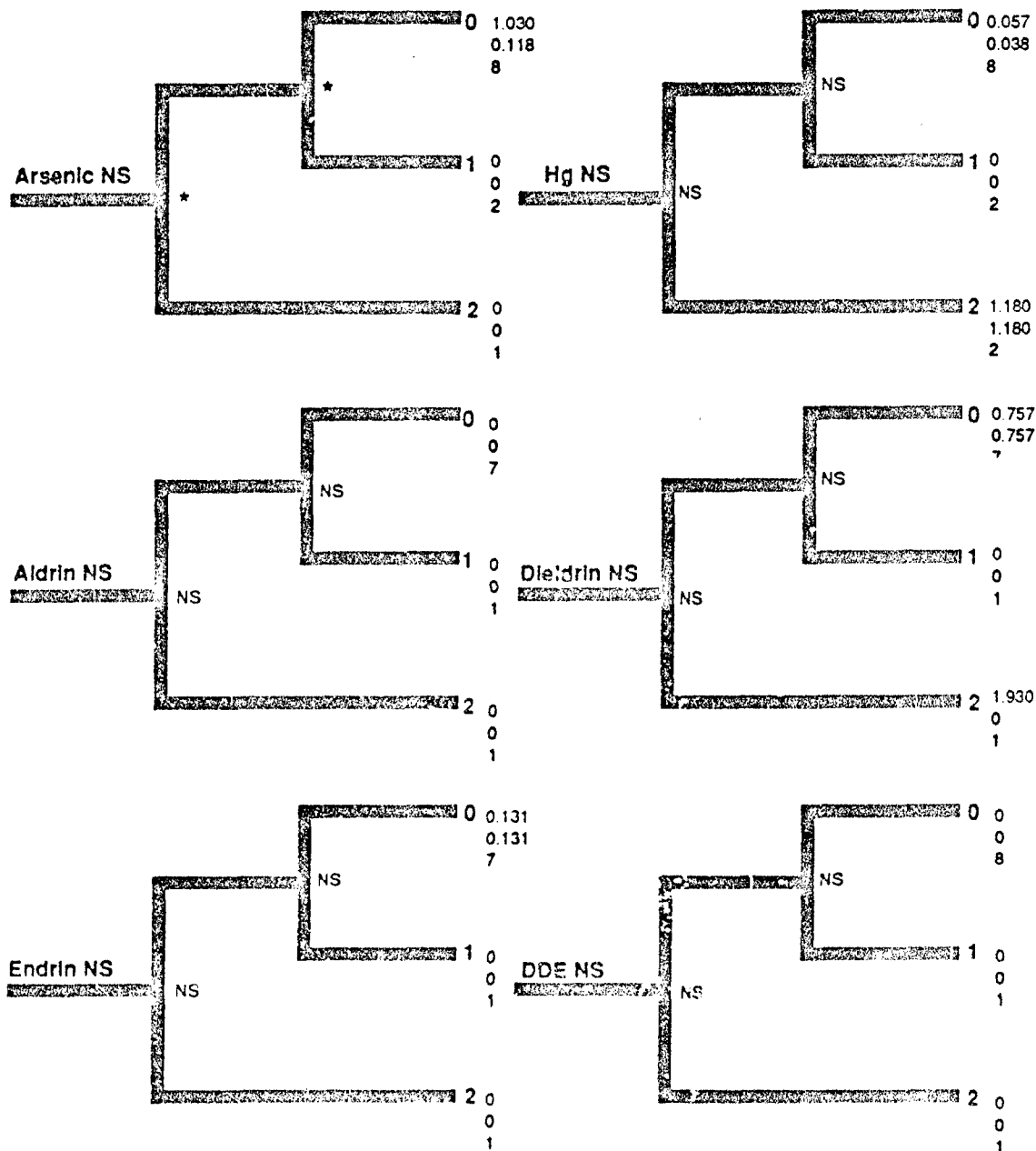
1.2 EARTHWORMS

Rationale

Data were available for seven contaminants. Three sites (onsite controls, offsite controls, and onsite contaminated areas) yielded specimens for statistical analyses. A priori contrasts included a comparison of onsite controls with offsite controls and a comparison of pooled controls with onsite contaminated areas.

Results

Only comparisons for arsenic yielded significant differences (Figure B.1-1). The preliminary ANOVA indicated significance differences among the three sites. Onsite controls differed from offsite controls, and the comparison of pooled controls with contaminated areas approached significance ($0.10 > p > 0.05$). Many potential differences between control and contaminated



EXPLANATION

NS = Not Significant ($P \geq 0.10$)
 ~NS = Approaches Significance ($0.10 \geq P > 0.05$)
 * = Significant ($0.05 \geq P > 0.01$)
 ** = Highly Significant ($0.01 \geq P > 0.001$)
 *** = Very Highly Significant ($0.001 \geq P$)

0 = On-site Control
 1 = Off-site Control
 2 = On-site Contaminated

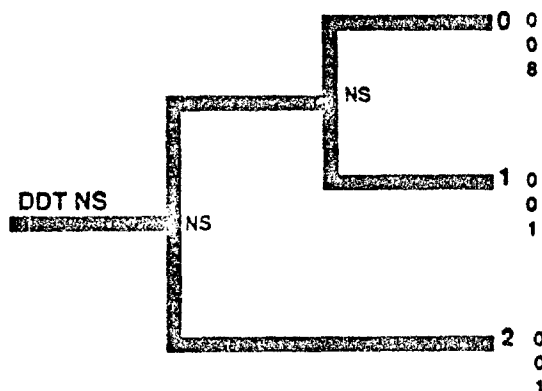
\bar{y} = Mean
 SY = Standard Error of Mean
 n = Sample Size

Figure B.1-1 (1 of 2)
 STATISTICAL ANALYSIS OF CONTAMINANTS
 IN EARTHWORMS

SOURCE: ESE, 1988

Prepared for:
 U.S. Army Program Manager's Office
 For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland



EXPLANATION

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Figure B.1-1 (2 of 2)
 STATISTICAL ANALYSIS OF CONTAMINANTS
 IN EARTHWORMS

SOURCE: ESE, 1988

Prepared for:
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sites may have remained undetected because of low sample sizes, especially for the contaminated site ($n = 2$).

1.3 GRASSHOPPERS

Rationale

Specimens were categorized according to site of capture from two contaminated areas (1 = RMA Section 36, 2 = RMA Section 26) and two control areas (3 = onpost control, 4 = offpost control). The hierarchical analyses included (1) contrast of Section 36 with Section 26, (2) contrast of the offpost control with the onpost control, and (3) contrast of the pooled data from control sites with the pooled data from contaminated sites. Sample sizes were small for each of the four groups. Data for all seven contaminants were available for analysis.

Results

Statistical results are summarized in Figure B.1-2. Mercury, DDE, and DDT failed to yield any significant differences. In addition to significance in the preliminary ANOVA, a significant difference in level of arsenic contamination was detected between contaminated sites and was approached ($0.10 > p > 0.05$) for the comparison of pooled contaminated and pooled control sites. Significant differences in levels of aldrin were detected in the preliminary ANOVA as well as between contaminated sites; significance was approached ($0.10 > P > 0.05$) for a difference between pooled contaminated and pooled control sites. Significance was obtained for all comparisons of dieldrin levels, except that between onpost and offpost controls. For endrin, differences among sites were significant among the four treatment groups in the preliminary ANOVA, as well as between the two contaminated sites.

1.4 MALLARDS

Rationale

Specimens were categorized into six groups according to age (egg, fledgling, adult) and site (contaminated and control). Four *a priori* contrasts were conducted and included (1) eggs from control versus contaminated sites, (2) fledglings from control versus contaminated sites, (3) adults from control

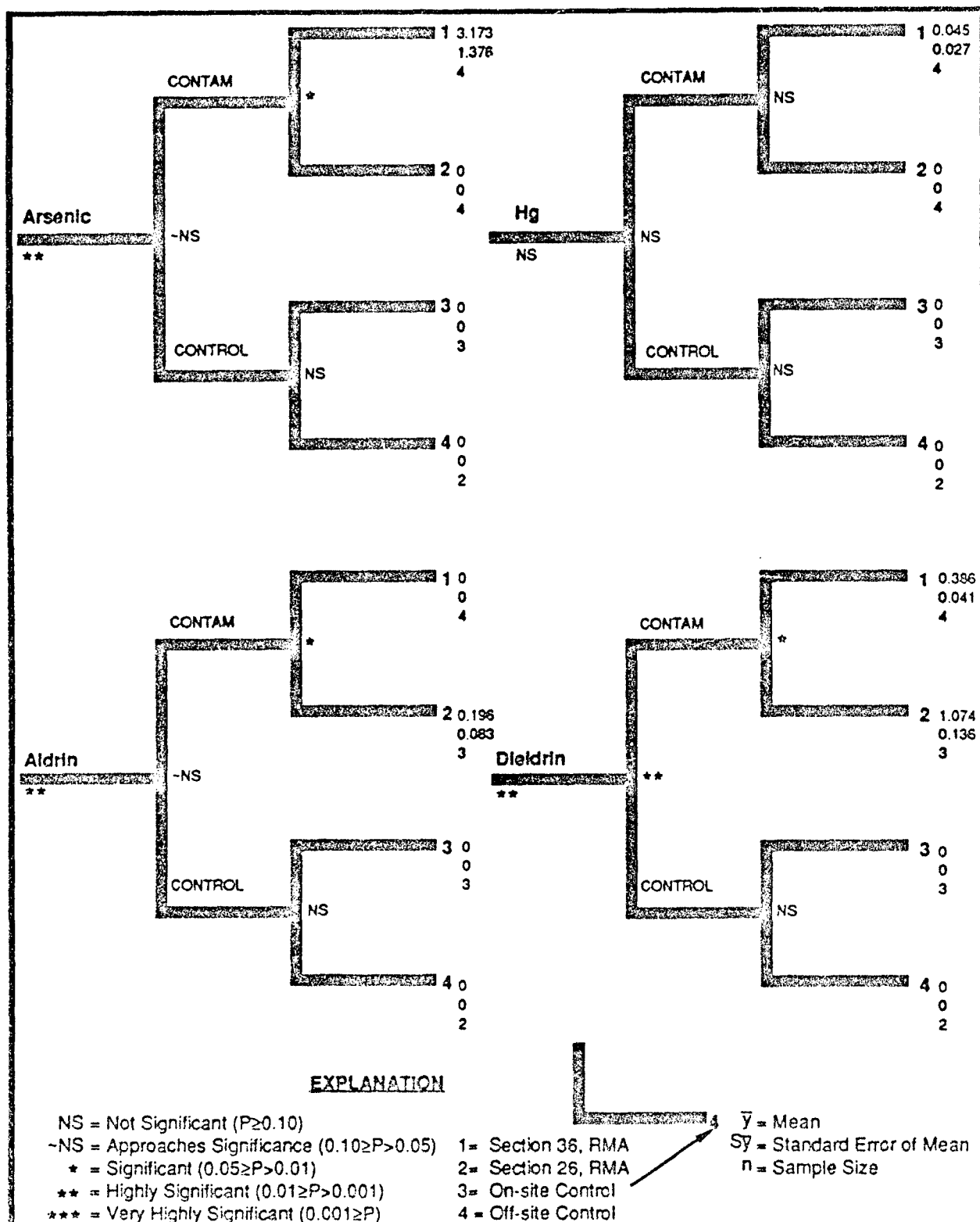
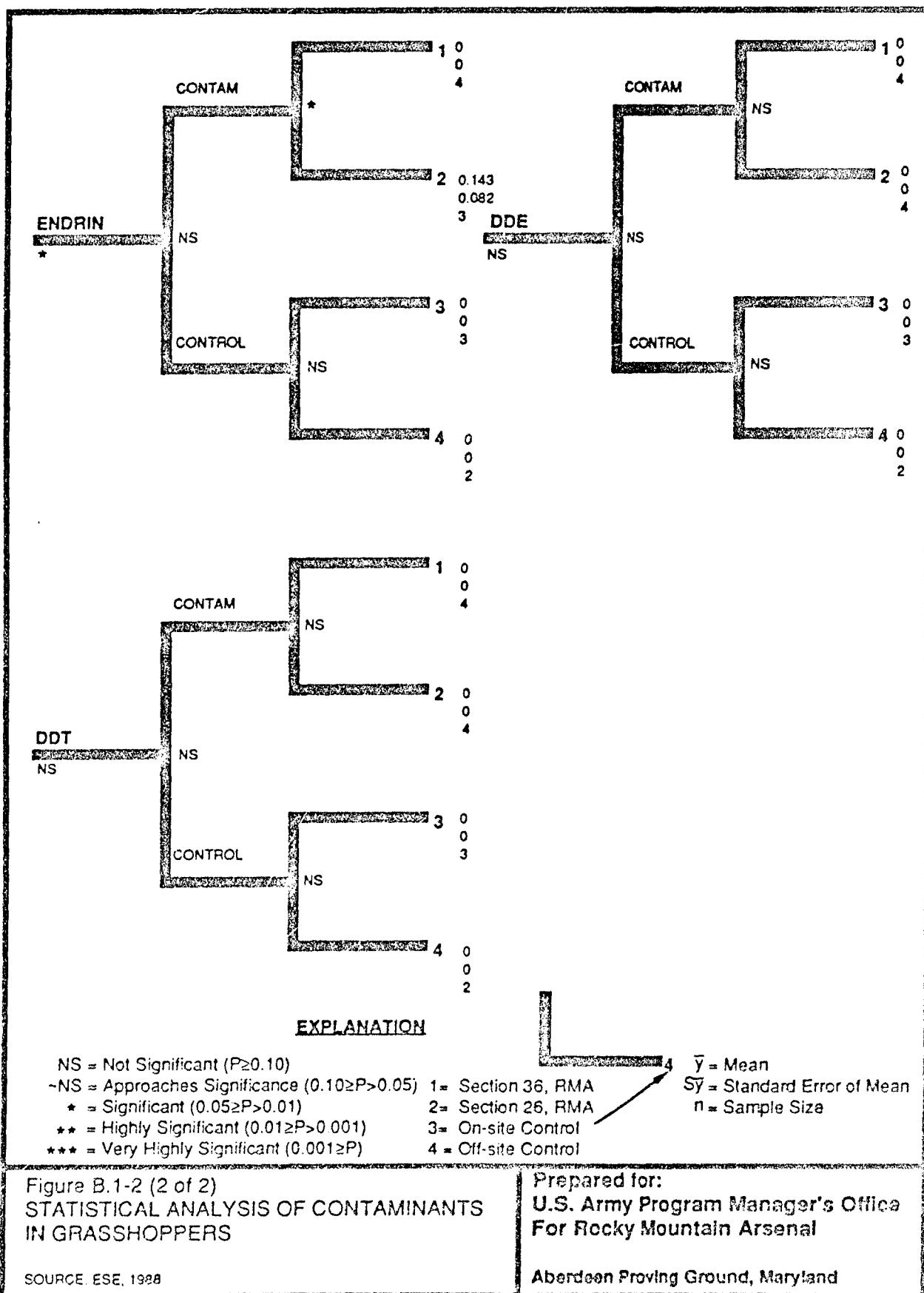


Figure B.1-2 (1 of 2)
 STATISTICAL ANALYSIS OF CONTAMINANTS
 IN GRASSHOPPERS

SOURCE: ESE, 1968

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versus contaminated sites, and (4) among age class comparisons in which the sites were pooled.

Results

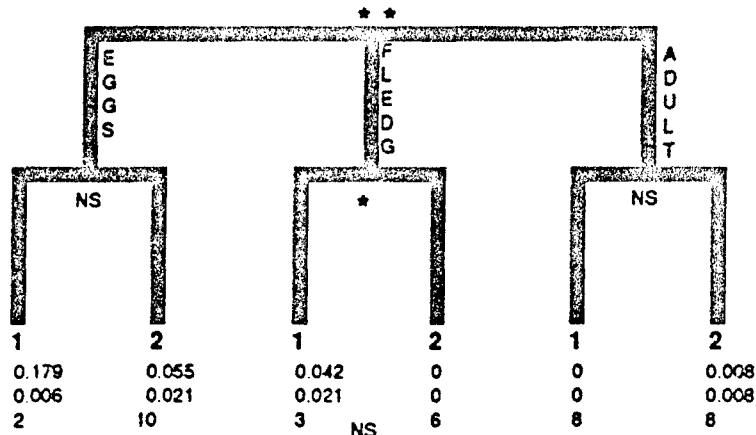
Data were available for all 7 dependent variable except arsenic. The results of the Kruskal-Wallis ANOVAs for each variable are presented in Figure B.1-3. For mercury, highly significant differences existed among the six treatment groups, and the a priori contrasts identified differences between fledglings from control and contaminated sites, as well as differences among age groups when contaminated and control sites were pooled. For eggs, significance was approached ($0.10 > p > 0.05$) for differences in mercury content between control and contaminated sites. For dieldrin, significant differences were identified between control and contaminated sites for eggs ($p < 0.001$) and fledglings ($0.05 > p > 0.01$); moreover, differences between control and contaminated sites approached significance ($0.10 > p > 0.05$) for adults. When sites were combined for each age group, no differences were detected among age groups. Although none of the statistical tests for DDE revealed significant differences among treatment groups, significance was approached ($0.10 > p > 0.05$) in the initial comparison of the six groups, as well as in the a priori contrasts of control and contaminated sites for eggs, and the comparison among age groups when sites were combined. Aldrin, endrin, and DDT were never detected in any tissues and all statistical comparisons were nonsignificant.

1.5 PHEASANT

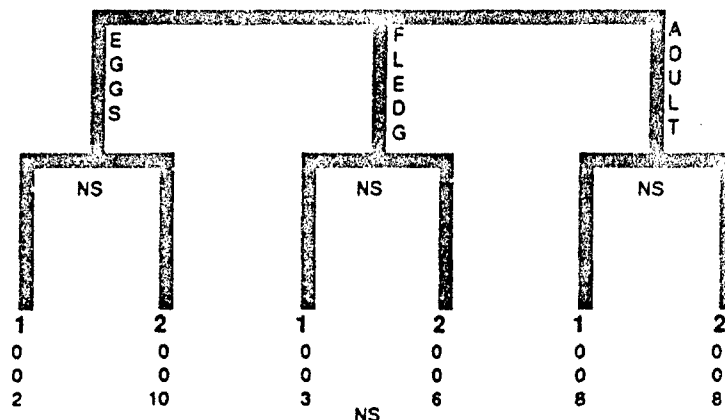
Rationale

Specimens were categorized according to site of capture (offpost control versus onsite contaminated areas) and age (egg, fledgling, or adult) into six groups (1 = onpost eggs, 2 = onpost fledglings, 3 = onpost adults, 4 = control eggs, 5 = control fledglings, and 6 = control adults). Few adult birds were obtained, especially from control areas (maximum $n = 2$). A priori contrasts included (1) comparison of onpost and control eggs, (2) comparison of onpost and control fledglings, (3) comparison of onpost and control adults, and (4) comparisons among the three age classes regardless of site of capture. Data were available for all seven contaminants.

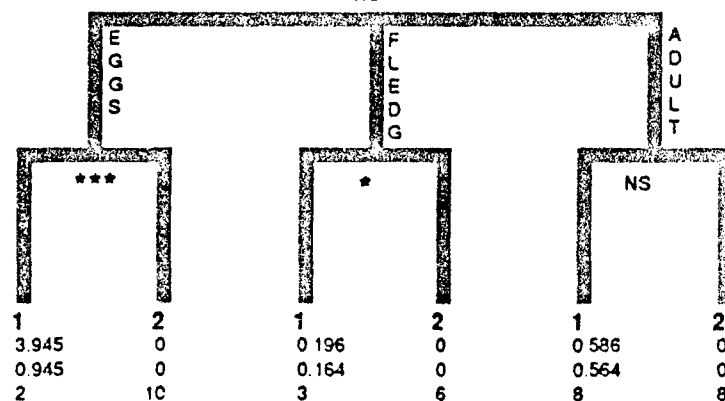
Hg **



Aldrin NS



Dieldrin ***



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1 = RMA
2 = Control

\bar{y} = Mean
SY = Standard Error of Mean
n = Sample Size

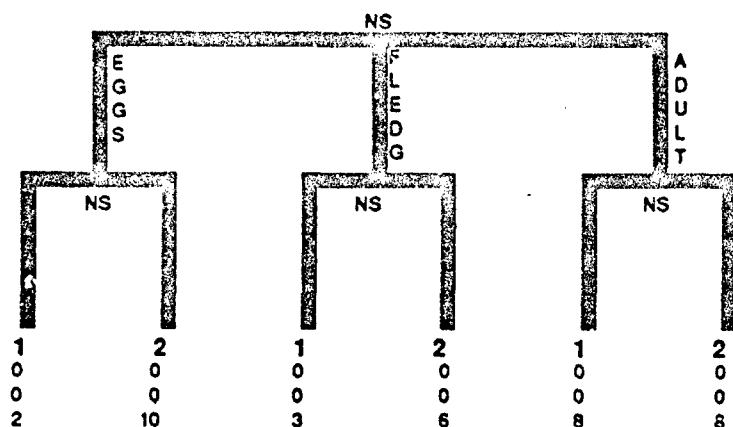
Figure B.1-3 (1 of 2)
STATISTICAL ANALYSIS OF CONTAMINANTS
IN MALLARDS

SOURCE ESE, 1978

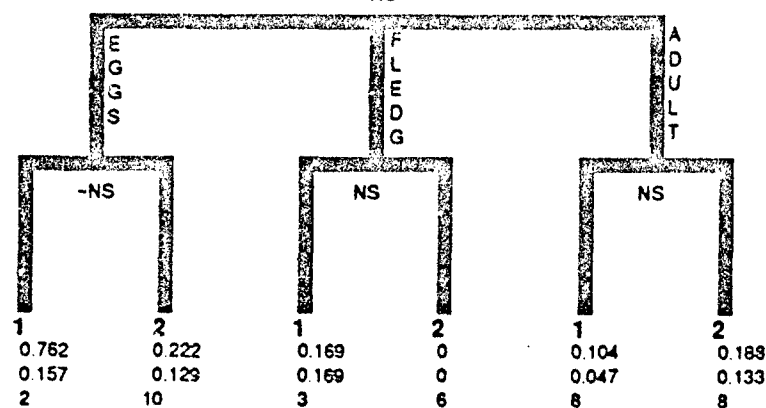
Prepared for:
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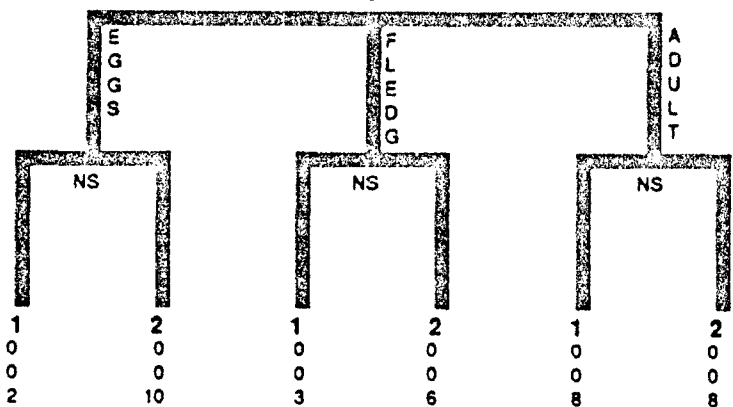
Endrin NS



DDE -NS



DDT NS



EXPLANATION

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- *** = Very Highly Significant ($0.001 \geq P$)

1 = RMA
2 = Control

\bar{y} = Mean
SY = Standard Error of Mean
n = Sample Size

Figure B.1-3 (2 of 2)
STATISTICAL ANALYSIS OF CONTAMINANTS
IN MALLARDS

SOURCE: ESE, 1968

Prepared for:
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For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland

Results

Statistical results are summarized in Figure B.1-4. No significant differences in levels of mercury, aldrin, endrin, DDE, or DDT were obtained for any contrasts. Although no significant differences in levels of arsenic Figure B.1-3 were detected between control and contaminated sites within any of the three age groups, significant differences were revealed among age groups, as well as in the preliminary ANOVA. In contrast, significant differences between control and onpost sites for eggs and for fledglings (but not for adults, probably due to small sample sizes) were obtained for dieldrin. The preliminary ANOVA was also significant for dieldrin.

1.6 COTTONTAIL_RABBITS

Rationale

Specimens were obtained from one contaminated area (1 = RMA Section 36) and from two control sites (2 = onpost control and 3 = offpost control). A priori contrasts included comparison of onpost and offpost controls, and comparisons of pooled controls with the contaminated site. Contaminant levels were obtained for arsenic, mercury, aldrin, dieldrin, and endrin.

Results

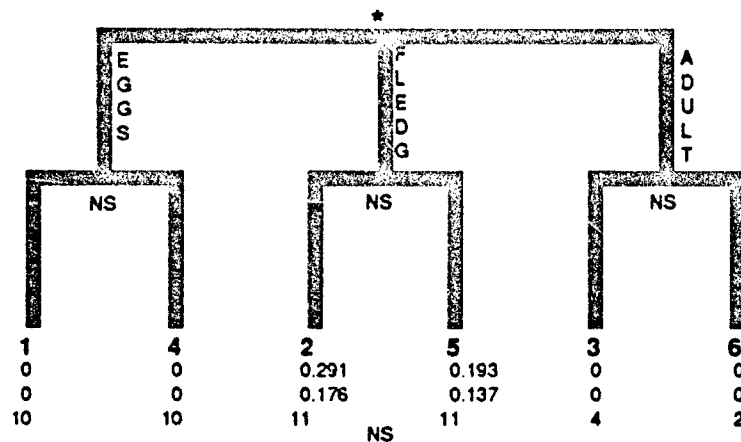
Statistical results are summarized in Figure B.1-5. No significant differences were obtained for any comparison of arsenic, mercury, aldrin, or endrin. Significance was approached ($0.10 > p > 0.05$) in the preliminary comparison of dieldrin levels among the three groups; the a priori contrast between pooled control sites and the contaminated site was significant.

1.7 DEER

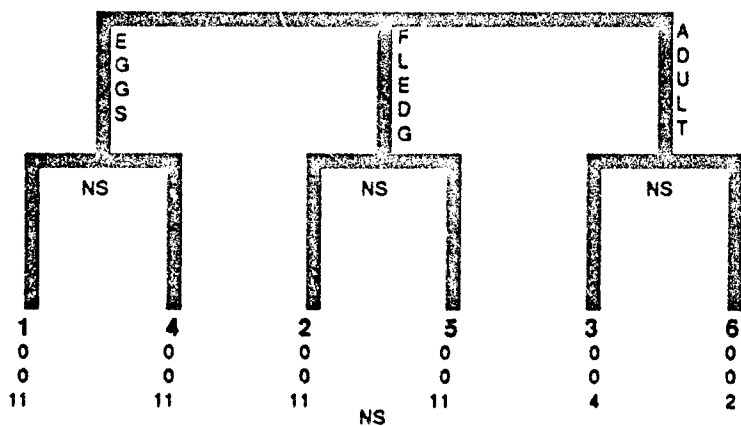
Rationale

Levels of contamination for arsenic, mercury, aldrin, dieldrin, and endrin were obtained from muscle and liver of specimens from contaminated sites and offpost control sites. Data were analyzed separately for liver and muscle to avoid problems of pseudoreplication (a liver and muscle sample was analyzed from each specimen). Moreover, a priori contrasts were not conducted because only two groups were distinguished in each analysis.

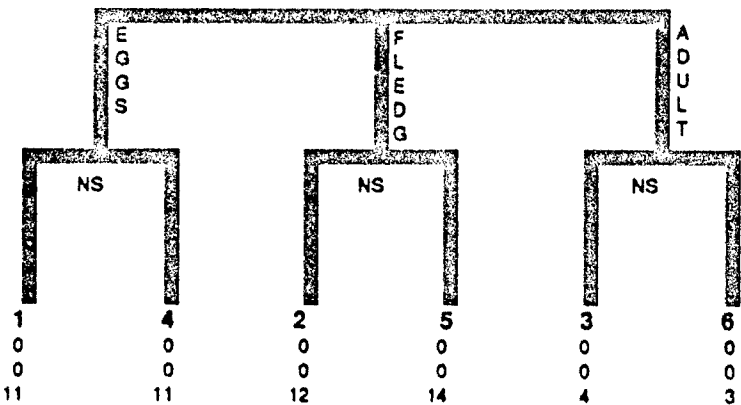
Arsenic NS



Hg NS



Aldrin NS



EXPLANATION

- NS = Not Significant ($P \geq 0.10$)
- NS = Approaches Significance ($0.10 \geq P > 0.05$)
- * = Significant ($0.05 \geq P > 0.01$)
- ** = Highly Significant ($0.01 \geq P > 0.001$)
- *** = Very Highly Significant ($0.001 \geq P$)

1, 2, or 3 = On-site Contaminated
4, 5, or 6 = Off-site Controls

2
 \bar{y} = Mean
 $S\bar{y}$ = Standard Error of Mean
n = Sample Size

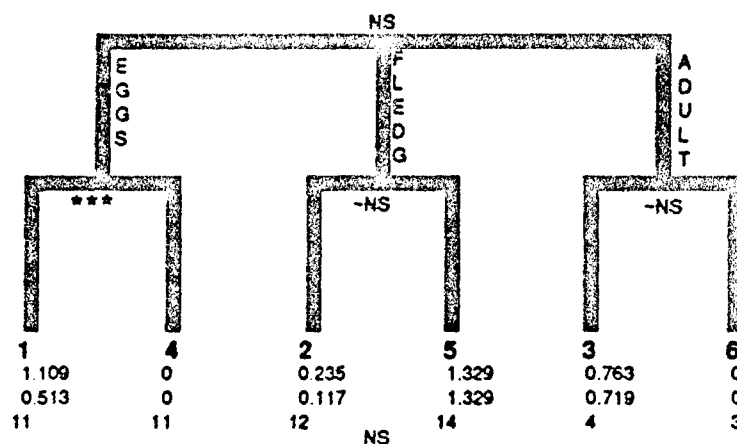
Figure B.1-4 (1 of 3)
STATISTICAL ANALYSIS OF CONTAMINANTS
IN RING-NECKED PHEASANTS

SOURCE: ESE, 1989

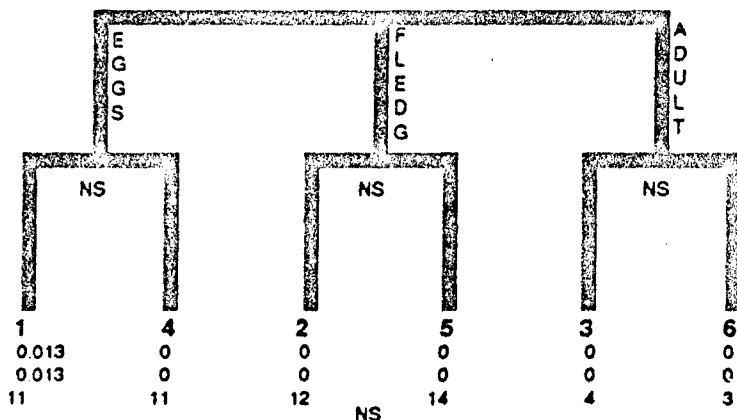
Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland

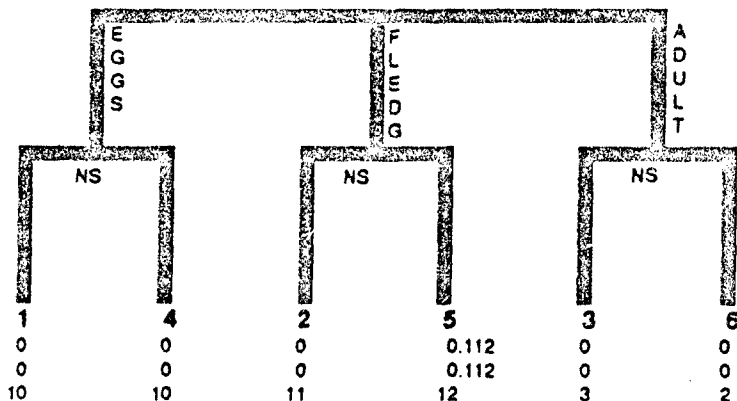
Dieldrin ***



Endrin NS



DDE NS



EXPLANATION

- NS = Not Significant ($P \geq 0.10$)
- NS = Approaches Significance ($0.10 \geq P > 0.05$)
- * = Significant ($0.05 \geq P > 0.01$)
- ** = Highly Significant ($0.01 \geq P > 0.001$)
- *** = Very Highly Significant ($0.001 \geq P$)

- 1, 2, or 3 = On-site Contaminated
- 4, 5, or 6 = Off-site Controls

- \bar{y} = Mean
- $S\bar{y}$ = Standard Error of Mean
- n = Sample Size

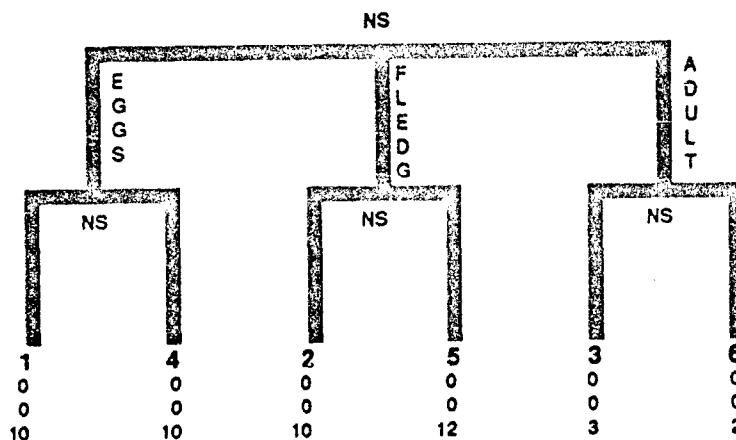
Figure B.1-4 (2 of 3)
STATISTICAL ANALYSIS OF CONTAMINANTS
IN RING-NECKED PHEASANTS

SOURCE: FFE, 1983

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland

DDT NS



EXPLANATION

- NS = Not Significant ($P \geq 0.10$)
- NS = Approaches Significance ($0.10 \geq P > 0.05$)
- * = Significant ($0.05 \geq P > 0.01$)
- ** = Highly Significant ($0.01 \geq P > 0.001$)
- *** = Very Highly Significant ($0.001 \geq P$)

1, 2, or 3 = On-site Contaminated
4, 5, or 6 = Off-site Controls

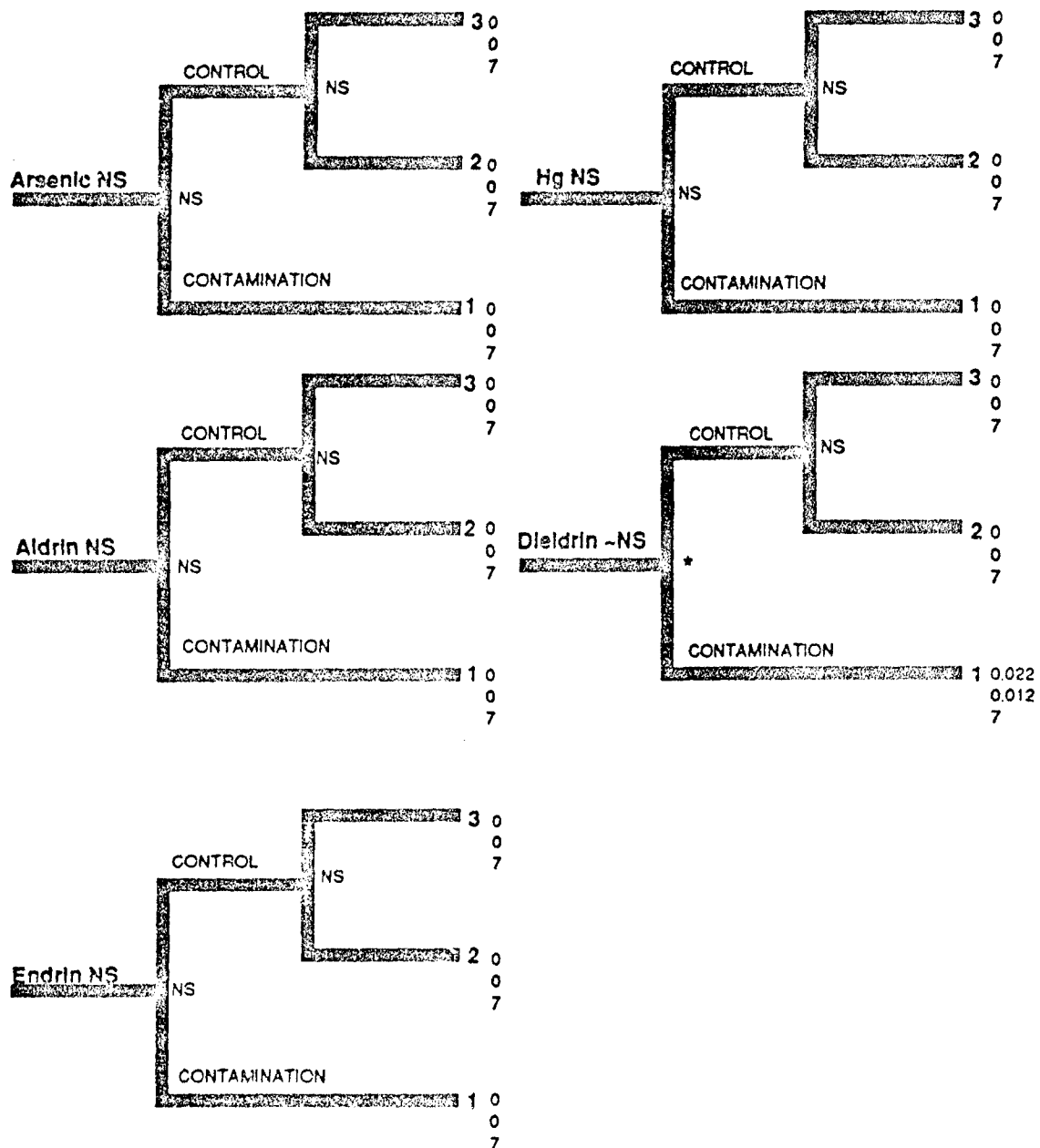
2
 \bar{y} = Mean
 $S\bar{y}$ = Standard Error of Mean
n = Sample Size

Figure B.1-4 (3 of 3)
STATISTICAL ANALYSIS OF CONTAMINANTS
IN RING-NECKED PHEASANTS

SOURCE: ESE, 1988

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland



EXPLANATION

NS = Not Significant ($P \geq 0.10$)
 ~NS = Approaches Significance ($0.10 \geq P > 0.05$)
 * = Significant ($0.05 \geq P > 0.01$)
 ** = Highly Significant ($0.01 \geq P > 0.001$)
 *** = Very Highly Significant ($0.001 \geq P$)

1 = Section 36, RMA
 2 = On-site Control
 3 = Off-site Control

\bar{y} = Mean
 SY = Standard Error of Mean
 n = Sample Size

Figure B.1-5
 STATISTICAL ANALYSIS OF CONTAMINANTS
 IN COTTONTAIL RABBITS

SOURCE: ESE, 1998

Prepared for:
 U.S. Army Program Manager's Office
 For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland

5/2/89

Results

Statistical results are summarized in Table B.1-1. No significant differences in levels of contamination in the liver were detected for any comparisons of control and contaminated sites. In fact, only dieldrin was detected at a measurable level in the liver of deer.

1.8 PRAIRIE DOGS

Rationale

Specimens were categorized by site and season, three samples represented control areas (i.e., summer onpost control = 2, summer offpost control = 3, winter onpost control = 6) and three represented contaminated areas (i.e., summer RMA Section 36 = 1, winter RMA Section 36 = 4, winter toxic yard = 6). The a priori contrasts included (1) comparison of summer and winter RMA 36, (2) comparison of pooled RMA data with the toxic storage yard data (3) comparison of winter and summer onpost controls (4) comparison of pooled onpost controls with summer offpost control, and (5) comparison of pooled control sites with pooled contaminated sites. Data for all dependent variables except DDE and DDT were available for statistical analysis.

Results

Statistical results are summarized in Figure B.1-6. Comparisons for mercury, aldrin, and endrin failed to yield any significant differences. Similarly, none of the comparisons for arsenic were significant; however, significance was approached ($0.10 > p > 0.05$) for the comparison of pooled control sites with pooled contaminated sites. In contrast, all comparisons were significant for dieldrin.

1.9 AMERICAN KESTREL

Rationale

Specimens were categorized by site of collection (1 = contaminated sites on RMA and 2 = offpost control areas) and age (egg or fledgling). A priori contrasts included (1) comparison of eggs from control and contaminated sites, (2) comparison of fledglings from control and contaminated sites, and (3) comparison of eggs to fledglings regardless of site of collection. Data were available for all contaminants except arsenic.

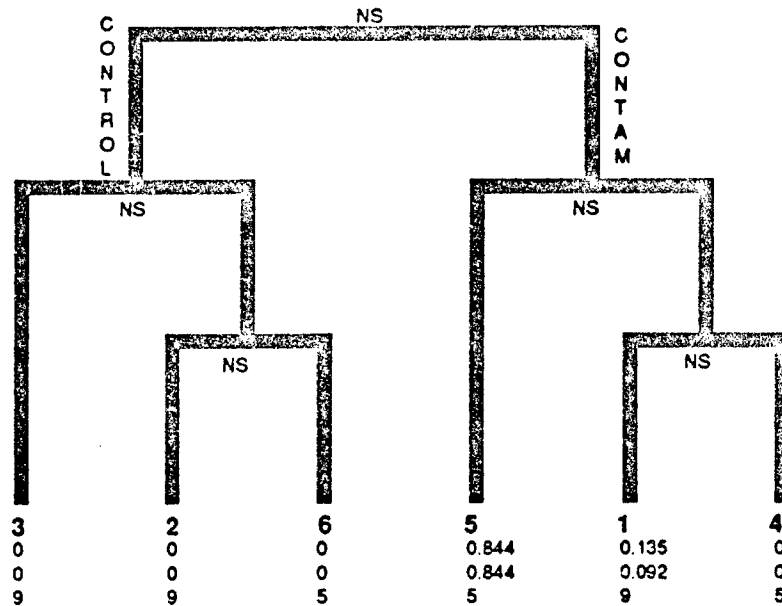
Table B.1-1. Statistical Analyses of Contamination in Mule Deer. No significant differences (Kruskal-Wallis one-way ANOVA by ranks) were obtained for differences between sites (control versus RMA) for any of the contaminants, regardless of tissue source.

	Muscle						Liver					
	RMA			Control			RMA			Control		
	Y	S \bar{y}	N	Y	S \bar{y}	N	Y	S \bar{y}	N	Y	S \bar{y}	N
Arsenic	0	0	14	0	0	2	0	0	14	0	0	2
Mercury	.001	.001	14	0	0	2	0	0	14	0	0	2
Aldrin	0	0	14	0	0	2	0	0	14	0	0	2
Dieldrin	0	0	14	0	0	2	.013	.013	14	0	0	2
Endrin	0	0	14	0	0	2	0	0	14	0	0	2

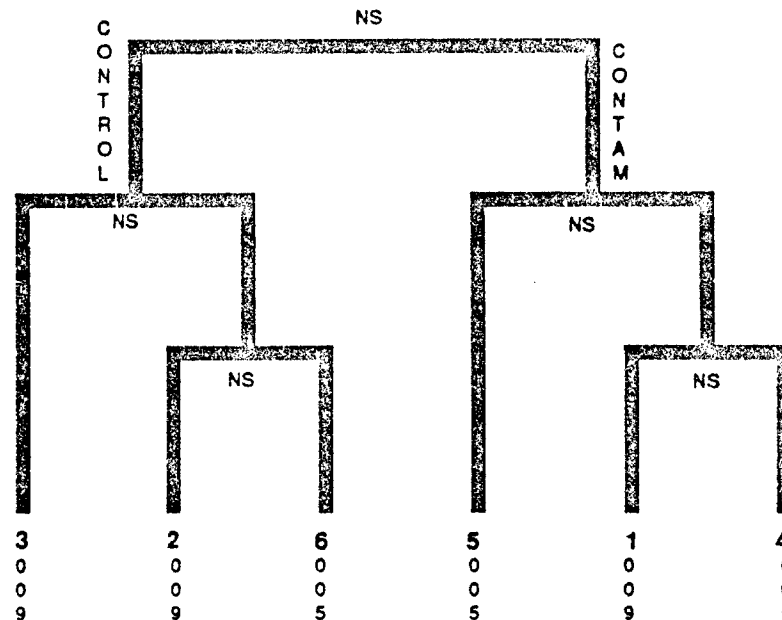
Y = Mean
S \bar{y} = Square of Mean
N = Sample Size

Source: ESE, 1988.

Arsenic NS



Hg NS



EXPLANATION

- NS = Not Significant ($P \geq 0.10$)
- NS = Approaches Significance ($0.10 \geq P > 0.05$)
- * = Significant ($0.05 \geq P > 0.01$)
- ** = Highly Significant ($0.01 \geq P > 0.001$)
- *** = Very Highly Significant ($0.001 \geq P$)

- 1 = Section 36, RMA (Summer)
- 2 = On-site Control (Summer)
- 3 = Off-site Control (Summer)
- 4 = Section 36, RMA (Winter)
- 5 = Toxic Storage Yard (Winter)
- 6 = On-site Control (Winter)

\bar{y} = Mean
 S_y = Standard Error of Mean
 n = Sample Size

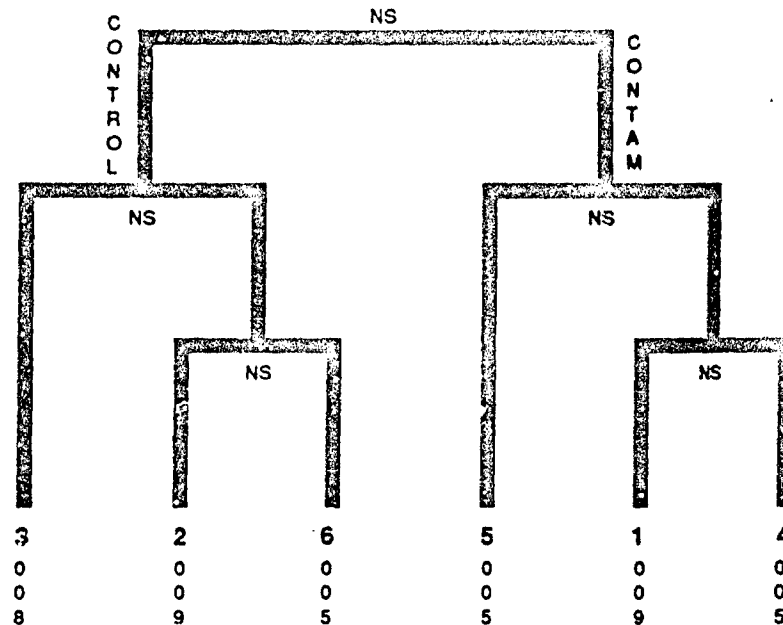
Figure B.1-6 (1 of 3)
 STATISTICAL ANALYSIS OF CONTAMINANTS
 IN BLACK-TAILED PRAIRIE DOGS

SOURCE ESE, 1989

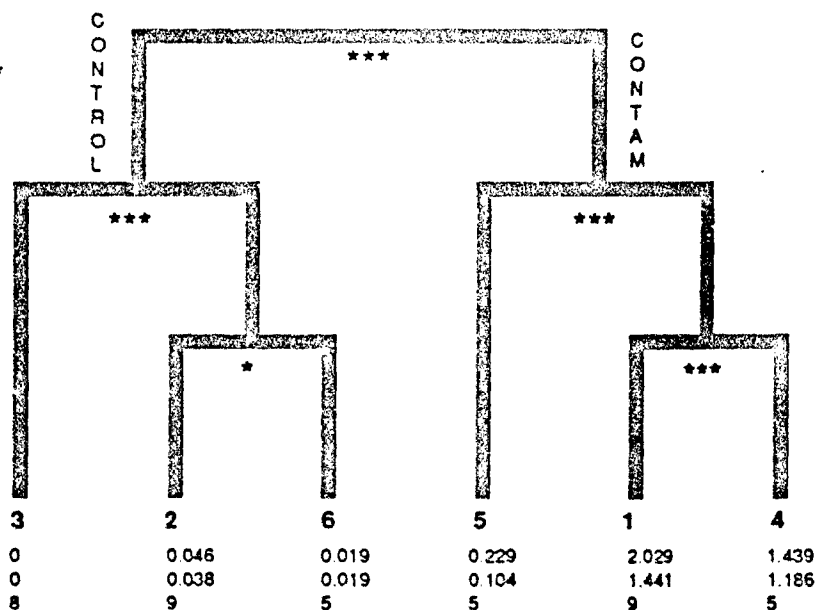
Prepared for:
 U.S. Army Program Manager's Office
 For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland

Aldrin NS



Dieldrin ***



EXPLANATION

- | | | |
|--|---------------------------------|--|
| NS = Not Significant ($P \geq 0.10$) | 1 = Section 36, RMA (Summer) | |
| -NS = Approaches Significance ($0.10 \geq P > 0.05$) | 2 = On-site Control (Summer) | |
| * = Significant ($0.05 \geq P > 0.01$) | 3 = Off-site Control (Summer) | |
| ** = Highly Significant ($0.01 \geq P > 0.001$) | 4 = Section 36, RMA (Winter) | |
| *** = Very Highly Significant ($0.001 \geq P$) | 5 = Toxic Storage Yard (Winter) | |
| | 6 = On-site Control Winter | |
| | | \bar{y} = Mean
Sy = Standard Error of Mean
n = Sample Size |

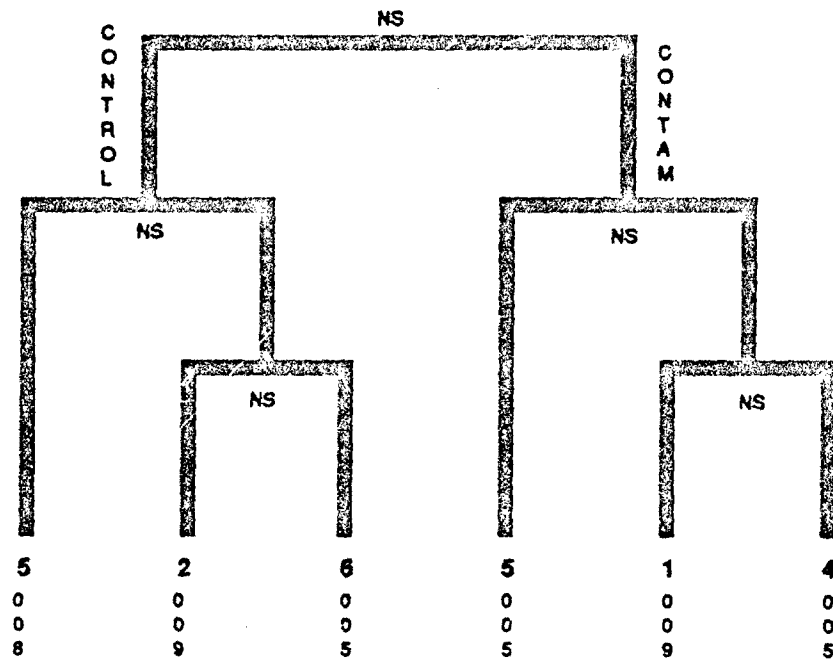
Figure B.1-6 (2 of 3)
STATISTICAL ANALYSIS OF CONTAMINANTS
IN BLACK-TAILED PRAIRIE DOGS

SOURCE: ESE, 1988

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland

Endrin NS



EXPLANATION

NS = Not Significant ($P \geq 0.10$)
 -NS = Approaches Significance ($0.10 \geq P > 0.05$)
 * = Significant ($0.05 \geq P > 0.01$)
 ** = Highly Significant ($0.01 \geq P > 0.001$)
 *** = Very Highly Significant ($0.001 \geq P$)

1 = Section 36, RMA (Summer)
 2 = On-site Control (Summer)
 3 = Off-site Control (Summer)
 4 = Section 36, RMA (Winter)
 5 = Toxic Storage Yard (Winter)
 6 = On-site Control Winter

\bar{y} = Mean
 S_y = Standard Error of Mean
 n = Sample Size

Figure B.1-6 (3 of 3)
 STATISTICAL ANALYSIS OF CONTAMINANTS
 IN BLACK-TAILED PRAIRIE DOGS

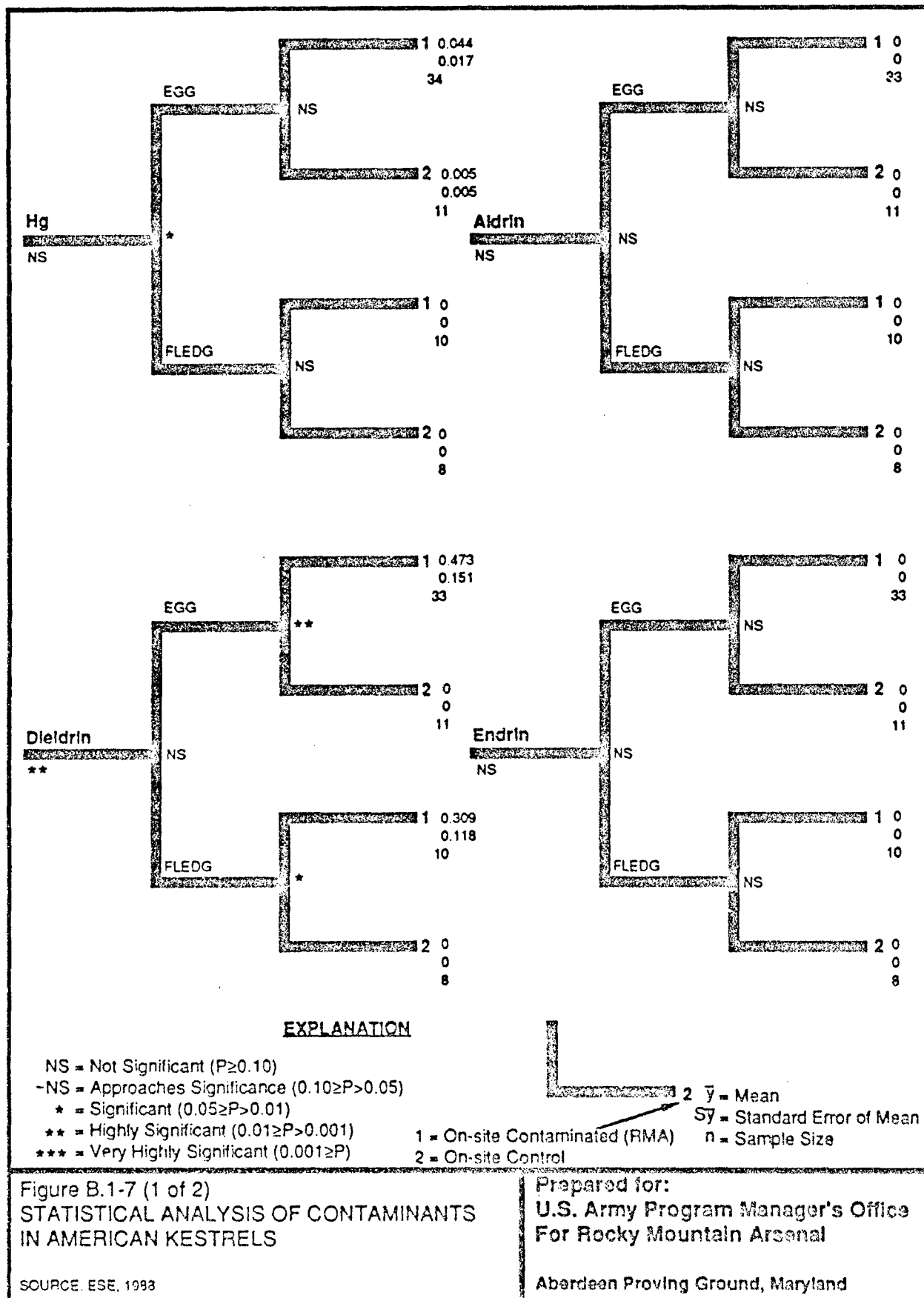
SOURCE: ESE, 1988

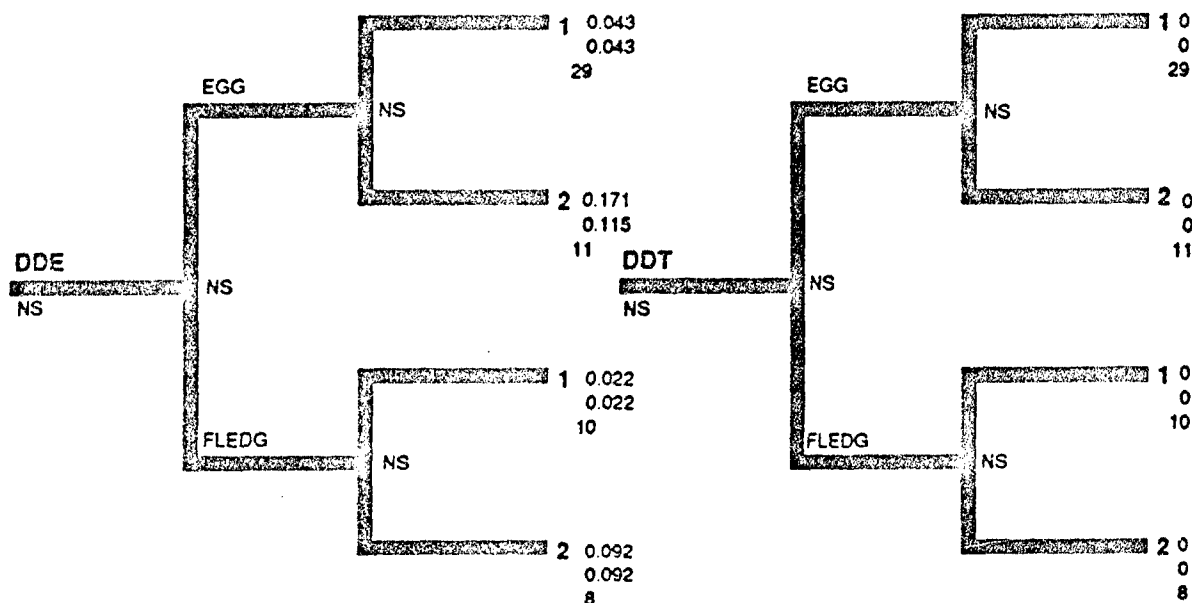
Prepared for:
 U.S. Army Program Manager's Office
 For Rocky Mountain Arsenal

Abardeen Proving Ground, Maryland

Results

Statistical results are summarized in Figure B.1-7. Data for aldrin, endrin, DDE, and DDT were never detected in any of the analyzed specimens. A significant difference between eggs and fledglings was obtained for mercury, but neither of the control versus contaminated comparisons were significant. For dieldrin, significance from the preliminary comparison of the four groups is partially resolved by the a priori contrasts in which differences between control and contaminated sites were detected for eggs as well as for fledglings.





EXPLANATION

- NS = Not Significant ($P \geq 0.10$)
- ~NS = Approaches Significance ($0.10 \geq P > 0.05$)
- * = Significant ($0.05 \geq P > 0.01$)
- ** = Highly Significant ($0.01 \geq P > 0.001$)
- *** = Very Highly Significant ($0.001 \geq P$)
- 1 = On-site Contaminated (RMA)
- 2 = On-site Control

\bar{y} = Mean
 S_y = Standard Error of Mean
 n = Sample Size

Figure B.1-7 (2 of 2)
STATISTICAL ANALYSIS OF CONTAMINANTS
IN AMERICAN KESTRELS

SOURCE: ESE, 1988

Prepared for:
U.S. Army Program Manager's Office
For Rocky Mountain Arsenal

Aberdeen Proving Ground, Maryland

2.0 STATISTICAL ANALYSES FOR CONTAMINATION EFFECTS

2.1 INTRODUCTION

This section is designed to briefly explain the results of statistical analyses of the Biota Assessment. Each section of this document corresponds to a particular data set and comprises three parts: (1) introductory remarks explaining the rationale of the analysis, (2) actual statistical results provided in tabular form and appended to the text, and (3) remarks as to the conclusions derived from the statistical analysis.

2.2 SNAILS

Rationale

Although snail densities and total weights were estimated from 7 sites in each of two years (1986 and 1987), the same sites were not evaluated in each year. In particular, Wellington B was unique to 1986 and Wellington C was unique to 1987. This lack of correspondence across years prevents a more powerful two way ANOVA or ANCOVA approach to evaluating the effect of year and contamination level on snail density or snail weight. In lieu of the more powerful factorial approach, a separate one way ANOVA comparing snail density cross sites was calculated for each year. Similarly, a separate one way ANOVA comparing total snail weight across sites was calculated for each year. For each of the two dependent variables, more powerful orthogonal a priori tests were conducted that compared the controls to each other (Wellington A versus B in 1986, and Wellington A versus C in 1987), the five contaminated lakes to each other (Lake Mary versus Gun Club versus Lake Derby versus Ladora versus North Bog in each year), and the controls as a group to the contaminated sites as a group. Again, ANOVA and the orthogonal a priori contrasts are considered to be robust with respect to deviations from homoscedasticity. Nonetheless, the very highly significant heteroscedasticity detected by the Fmax Test is of considerable concern; as such, Kruskal-Wallis one way ANOVA by ranks and associated non-parametric orthogonal a priori contrasts were conducted as a fail safe measures.

In order to control for the possible confounding effects on snails of differences among samples in temperature, pH, and vegetation weight (referred to as covariates hereafter), each of these three factors was used as an independent variable in a multiple regression for snail density in

5/2/89

1986, snail density in 1987, total snail weight in 1986, and total snail weight in 1987. The residuals from each of these four analyses were saved and used as dependent variables in four separate sets of a priori contrasts and ANOVAs.

Results

Tables B.2-1, B.2-2, B.2-3, and B.2-4 report the statistical results of parametric and non-parametric analyses as well as descriptive group statistics for snail density in 1986, snail density in 1987, total snail weight in 1987, and total snail weight in 1987, respectively.

Remarks

Variances were very highly heteroscedastic for all four analyses ($p \ll 0.001$). Even though the results of the parametric analyses are reported in full, subsequent consideration will only focus on the results from the Kruskal-Wallis one way ANOVA by ranks (for both usual and residual ANOVAs).

- o Density 1986--The significant differences among the seven sites were, in part, affected by differences between controls, differences among the contaminated sites, and differences between controls as a group and contaminated sites as a group (Table B.2-1). Although the covariates significantly affected snail density, similar differences among sites persisted in the ANOVA by ranks on the residuals, with the exception that mean values among the contaminated sites were indistinguishable.
- o Density 1987--The significant differences among the seven sites were, in part, affected by differences between controls, differences among the contaminated sites, and differences between controls as a group and contaminated sites as a group (Table B.2-2). Although the covariates significantly affected snail density, similar differences among sites persisted in the ANOVA by ranks on the residuals, with the exception that mean differences between control sites as a group and contaminated sites as a group did not obtain significance.

Table B.2-1. Statistical Results of Parametric and Non-Parametric Analyses for Snail Density, 1986.

Above--One Way ANOVA and Orthogonal A Priori Comparisons of Snail Density Among the Seven Treatment Groups (NS, Not Significant with $P > 0.05$). Significance of the Non-parametric Tests was Identical to That of the Parametric Tests Except Where Noted by ¹, in Which Case the Non-parametric Test was Significant at $p < 0.001$.

Below--Descriptive Statistics.

Source of Variation	ANOVA				KW	Significance
	DF	SS	MS	F		
Among	6	2,309,575	384,929	6.905	46.228	0.001 > p
Between Controls	1	818,101	818,101	14.675	7.000	0.001 > p
Among Contaminants	4	442,858	110,715	1.986	28.695	NS ¹
Controls vs. Contam.	1	969,995	969,995	17.399	20.516	0.001 > p
Within	63	3,512,166	55,749			
Total	69	5,821,741	84,373			

F_{max} test of homoscedasticity: F_{max} = 27,996.4; DF = 9,6; P << 0.001.

Treatment	Mean	N	Variance	Standard Error
Controls				
Wellington A	563.100	10	126,725.322	112.584
Wellington B	158.600	10	24,672.711	49.672
Contaminated				
Lake Mary	118.200	10	4,548.622	21.327
Gun Club	258.900	10	224,278.989	149.759
Lake Derby	2.700	10	8.011	0.895
Ladora	9.700	10	83.344	2.887
North Bay	60.100	10	9,896.767	31.459

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

KW = Test Statistic From a Kruskal-Wallis One Way ANOVA by Ranks

N = Sample Size

Source: ESE, 1988

Table B.2-2. Statistical Results of Parametric and Non-Parametric Analyses for Snail Density, 1987.

Above--One Way ANOVA and Orthogonal A Priori Comparisons of Snail Density Among the Seven Treatment Groups (NS, Not Significant with $p < 0.05$). Significance of the Non-parametric Tests was Identical to That of the Parametric Test Except Where Noted by ¹, in Which Case the Non-parametric Test was Significant at $p < 0.001$.

Below--Descriptive Statistics.

Source of Variation	ANOVA				KW	Significance
	DF	SS	MS	F		
Among	6	1,385.033	230.839	15.440	43.798	0.001 > p
Between Controls	1	767.536	767.536	51.340	13.176	0.001 > p
Among Contaminants	4	31.925	7.981	0.533	21.404	NS ¹
Controls vs. Contam.	1	585.572	585.572	39.169	23.632	0.001 > p
Within	63	941.872	14.950			
Total	69	2,326.875	33.722			

F_{max} test of homoscedasticity: F_{max} = 6,424.6; DF = 9,6; P << 0.000.

Treatment	Mean	N	Variance	Standard Error
Controls				
Wellington A	428.100	10	80,237.211	89.575
Wellington B	36.300	10	434.011	6.588
Contaminated				
Lake Mary	43.000	10	5,417.333	23.275
Gun Club	23.300	10	424.622	6.516
Lake Derby	2.600	10	12.489	1.118
Ladora	71.800	10	17,926.844	42.340
North Bay	8.100	10	199.878	4.471

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

KW = Test Statistic From a Kruskal-Wallis One Way ANOVA by Ranks

N = Sample Size

Source: ESE, 1988

Table B.2-3. Statistical Results of Parametric and Non-Parametric Analyses for Total Snail Weight, 1986.

Above--One-Way ANOVA and Orthogonal A Priori Comparisons of Total Snail Weight Among the Seven Treatment Groups (NS, Not Significant with $p > 0.05$). Significance of the Non-parametric Tests that Differed from that of the ANOVA are Indicated by Numeric Superscripts (² indicates $p < 0.001$; and ³ indicates $0.01 > p > 0.001$).

Below--descriptive statistics.

Source of Variation	ANOVA				KW	Significance
	DF	SS	MS	F		
Among	6	106.38	17.813	3.605	49.885	$0.01 > p > 0.001^2$
Between Controls	1	17.47	17.466	3.535	8.698	NS ²
Among Contaminants	4	80.80	20.200	4.088	33.665	$0.01 > p > 0.001^2$
Controls vs. Contam.	1	7.20	7.197	1.457	14.557	NS ³
Within	63	311.29	4.941			
Total	69	418.17	6.060			

F_{\max} test of homoscedasticity $F_{\max} = 58,900.8$; DF = 9,6; $P < 0.001$.

Treatment	Mean	N	Variance	Standard Error
Controls				
Wellington A	2.676	10	2.454	0.495
Wellington B	0.807	10	0.729	0.270
Contaminated				
Lake Mary	1.195	10	2.410	0.491
Gun Club	3.356	10	28.903	1.700
Lake Derby	0.012	10	<0.001	0.004
Ladora	0.057	10	0.006	0.025
North Bay	0.205	10	0.084	0.091

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

KW = Test Statistic From a Kruskal-Wallis One Way ANOVA by Ranks

N = Sample Size

Source: ESE, 1988

Table B.2-4. Statistical Results of Parametric and Non-Parametric Analyses for Total Snail Weight, 1987.

Above--One Way ANOVA and Orthogonal A Priori Comparisons of Total Snail Weight Among the Seven Treatment Groups (NS, Not Significant with $p > 0.05$). Significance of Non-parametric Tests, if Different from the ANOVA, are Indicated by Numeric Superscripts (² indicates $0.01 > p > 0.001$).

Below--Descriptive Statistics.

Source of Variation	ANOVA				KW	Significance
	DF	SS	MS	F		
Among	6	31.498	5.250	5.199	38.546	0.001 > p
Between Controls	1	8.844	8.844	15.489	3.727	NS
Among Contaminants	4	1.425	0.356	0.623	14.308	NS ²
Controls vs. Contam.	1	21.228	21.288	37.177	28.585	0.001 > p
Within	63	35.951	0.571			
Total	69	67.499	0.977			

F_{max} test of homoscedasticity F_{max} = 1,100.0; DF = 9,6; P << 0.001.

Treatment	Mean	N	Variance	Standard Error
Controls				
Wellington A	2.160	10	2.200	0.469
Wellington B	0.830	10	0.256	0.160
Contaminated				
Lake Mary	0.130	10	0.013	0.037
Gun Club	0.410	10	0.188	0.137
Lake Derby	0.020	10	0.002	0.013
Ladora	0.400	10	0.472	0.207
North Bay	0.380	10	0.831	0.288

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

KW = Test Statistics a Kruskal-Wallis One Way ANOVA by Ranks

N = Sample Size

Source: ESE, 1988

5/2/89

- o Weight 1986--The significant differences among the seven sites were, in part, affected by differences between controls, differences among the contaminated sites, and differences between controls as a group and contaminated sites as a group (Table B.2-3). Although the covariates significantly affected total snail weight, similar differences among sites persisted in the ANOVA by ranks on the residuals without exception.
- o Weight 1987--The significant differences among the seven sites were, in part, affected by differences among the contaminated sites, and differences between controls as a group and contaminated sites as a group (Table B.2-4). Although the covariates significantly affected total snail weight, similar differences among sites persisted in the ANOVA by ranks on the residuals, with the exception that an additional difference between controls was revealed.

2.3 GRASSHOPPER DENSITY

Rationale

Mean grasshopper densities were estimated from counts derived from three groups: onpost controls (N = 10), offpost controls (N = 26), and contaminated sites (N = 21). Although Bartlett's Test indicated significant heterogeneity among group variances using untransformed ($X^2 = 77.420$; $DF = 2$; $p \gg 0.05$) or square root transformed data ($X^2 = 27.980$; $DF = 2$; $p \gg 0.05$), the ANOVA is robust with respect to heteroscedasticity. A logical sequence of a priori comparisons (comparing onpost and offpost controls, then comparing combined controls (both onpost and offpost) to the contaminated site) were then conducted as well. Because of the high degree of heteroscedasticity, parallel non-parametric analyses were calculated as a fail safe measure. If parametric and non-parametric results agree, then one can be confident of the statistical interpretations, regardless of the inherent assumptions of the two kinds of analyses.

Differences in time of day, temperature, and floral characteristics (height and density) associated with each of the quadrats could have a confounding affect on grasshopper density beyond that directly associated with the

5/2/89

statistical treatments described above. The effect of all four of these variables were statistically removed via multiple regression analysis, and the residual variation subjected to analyses that were analogous to those described above.

Results

Table B.2-5 contains the results of parametric and non-parametric ANOVA, a priori tests, and descriptive statistics on the untransformed data;

Table B.2-6 contains the results of the multiple regression analysis, as well as the parametric and non-parametric ANOVA and a priori tests on the residuals from the multiple regression analysis.

Remarks

The overall ANOVA, as well as each of the a priori comparisons, were non-significant, indicating a lack of treatment effect on mean grasshopper density for the untransformed data as well as the residuals. The differences in degrees of freedom between analyses of untransformed data and residuals occurs because floral characteristics were not available for all the data, effectively reducing sample sizes for analyses involving the residuals from the multiple regression analysis.

2.4 EARTHWORM DENSITY

Rationale

Estimates of worm density from three sites (Barr Lake Control, N=4; Section 5 Control, N=5; and South Plant Contaminated, N=5) were statistically compared using a hierarchical set of orthogonal comparisons via the ANOVA (and a priori comparisons) as well as via non-parametric Kruskal-Wallis one way ANOVA by ranks. Controls were first compared to each other, then the controls as a group were compared simultaneously. Although the parametric tests are robust with respect to moderate deviations from homoscedasticity, Bartlett's Test indicated heteroscedasticity ($p < 0.05$), and the non-parametric tests were conducted to validate the results of the ANOVA.

Results

Table B.2-7 contains the result of all statistical analyses.

5/3/89

Table B.2-5. Statistical Analysis of Grasshopper Density.

Above--One Way ANOVA and Orthogonal A Priori Comparisons of Grasshopper Density Among the Three Treatment Groups. Statistical Results are Identical for Both Parametric and Non-parametric Tests.

Below--Descriptive Statistics.

Source of Variation	ANOVA				KW	Significance
	DF	SS	MS	F		
Among	2	701.4	350.73	3.00	3.168	NS
Between Controls	1	430.7	430.68	3.69	0.844	NS
Controls vs. Contam.	1	270.8	270.78	2.32	1.779	NS
Within	54	6,304.7	116.75			
Total	56	7,006.1	125.11			

Bartlett's test of homoscedasticity: $\chi^2 = 77.420$; DF = 2; P > 0.05.

Treatment	Mean	N	Variance	Standard Error
Control	1.524	21	4.262	0.450
Contaminated				
Onpost	8.923	26	247.274	3.084
Offpost	2.800	10	4.178	0.646

KW = Test Statistic From Kruskal-Wallis One Way ANOVA by Ranks

NS = Not Significant with $p > 0.05$

N = Sample Size

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

Source: ESE, 1988

Table B.2-6. Multiple Regression Analysis of Grasshopper Density and Analysis of Residuals From the Multiple Regression Analysis.

Above -- Multiple Regression Analysis of Grasshopper Density as a Function of Time, Temperature, Vegetation Height, and Vegetation Density (= Model). Multiple R^2 of the Model was Low (0.128); Simple Correlations with Grasshopper Density by Time, Temperature, Vegetation Height, and Vegetation Weight were 0.007, 0.064, -0.070, -0.343, Respectively.

Below -- One Way ANOVA and Orthogonal A Priori Comparisons of Grasshopper Density Among the Three Treatment Groups. Statistical Results are Identical for Both Parametric and Non-parametric Tests.

Source of Variation	DF	SS	MS	F	Significance
Model	4	766.3	191.58	1.32	NS
Error	36	5228.5	145.24		
Total	40	5994.8	149.87		

Source of Variation	ANOVA				KW	Significance
	DF	SS	MS	F		
Among	2	575.3	287.67	2.35	1.877	NS
Between controls	1	202.0	202.03	1.65	0.314	NS
Controls vs. Contams.	1	373.3	373.31	3.05	1.590	NS
Within	38	4653.2	122.45			
Total	40	5228.5	130.71			

KW = Test Statistic From Kruskal-Wallis One Way ANOVA by Ranks

NS = Not Significant with $p > 0.05$

N = Sample Size

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

Source: ESE, 1988.

5/3/89

Table B.2-7. Statistical Analysis of Earthworm Density

Above -- One Way ANOVA and Orthogonal A Priori Comparisons of Worm Density Among the Three Treatment Groups. Statistical Results of the More Conservative Non-parametric Tests are Reported (Significance of the Parametric Analyses was Consistently Less than 0.001).

Below--Descriptive Statistics.

Source of Variation	ANOVA				KW	Significance
	DF	SS	MS	F		
Among	2	9,181.0	4,590.50	42.14	9.861	0.01 > p > 0.001
Between Controls	1	6,360.6	6,360.56	58.41	6.050	0.01 > p > 0.001
Control vs. Contams.	1	2,820.5	2,830.46	25.90	4.049	0.05 > p > 0.01
Within	11	1198.2	108.93			
Total	13	10379.2	798.40			

Bartlett's Test of Homoscedasticity: $X^2 = 8.691$; DF = 2; $0.01 < p < 0.05$.

Treatment	Mean	N	Variance	Standard Error
Contaminated	2.600	5	33.800	2.600
Control				
Barr	2.500	4	9.000	1.500
Section 5	56.000	5	259.000	7.197

KW = Test Statistics From Kruskal-Wallis One Way ANOVA by Ranks

NS = Not Significant with $p > 0.05$

N = Sample Size

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

Source: ESE, 1988.

Remarks

Results of non-parametric and parametric tests were in agreement for all analyses. The overall significant differences among groups were further resolved in that the two controls differed from each other, and that despite this difference, the combined control group was different from the contaminated site.

2.5 ACETYLCHOLINESTERASE (ACHE) ACTIVITY

2.5.1 PRAIRIE DOGS

Rationale

Specimens were obtained from four locales (Sections 36, 31, onpost control and offpost control), each of which constitutes a statistical treatment group. Sections 36 and 31 are contaminated sites whereas onpost and offpost controls represent sites without direct evidence of contamination. One way analysis of variance (ANOVA) was conducted to evaluate the existence of mean treatment effects among the four groups. More powerful a priori tests were conducted to compare the two controls to each other, the two contaminated sites to each other, and the combined control sites to the combined contaminated sites. Although the ANOVA and a priori tests were relatively robust with respect to inequality of variances (heteroscedasticity) for the statistical treatment groups, many a posteriori test are quite sensitive to deviations from homoscedasticity. Bartlett's Test (Sokal and Rohlf, 1981), indicated that variances were homoscedastic ($\chi^2 = 5.168$, $DF = 3$, $p < 0.05$), hence the SNK test was used to make all possible comparisons among treatment groups. Although less powerful than either ANOVA or a priori tests, the SNK test does facilitate particular pair-wise comparisons that the other two analyses cannot evaluate.

Results

Table B.2-8 contains the descriptive statistics and results of the ANOVA, orthogonal a priori tests, and a posteriori results from the SNK test.

Remarks

The ANOVA clearly detected the existence of at least one group with a mean level of AChE that differed from the others ($p < 0.01$). Moreover, the a priori tests detected significant differences between the two control sites

Table B.2-8. Statistical Analysis of AChE Activity in Prairie Dogs.

Above--One Way ANOVA and Orthogonal A Priori Comparisons of AChE Activity Among Four Treatment Groups.

Below--Descriptive Statistics and Results of A Posteriori Comparisons Using the Student-Neuman-Kuel's Test; Treatment Means with Identical Letter Superscripts are Statistically Indistinguishable at the 0.05 Level of Significance.

Source of Variation	DF	SS	MS	F	Significance
Among	3	104.3	34.78	6.48	0.01 > p > 0.001
Sites 36 versus 31	1	32.9	32.89	6.12	0.05 > p > 0.01
Control Onpost vs. Offpost	1	26.7	26.73	4.98	0.05 > p > 0.01
Control vs. Contam.	1	44.7	44.72	8.32	0.01 > p > 0.001
Within	35	187.8	5.37		
Total	38	292.2	7.69		

Bartlett's test of homoscedasticity: $X^2 = 5.636$; DF = 3; P > 0.05.

Treatment	Mean	N	Variance	Standard Error
Contaminated				
Section 31	10.690 ^a	5	2.304	0.679
Section 36	13.678 ^{a,b}	14	3.870	0.526
Control				
Onpost	14.090 ^{a,b}	12	3.901	0.570
Offpost	16.450 ^b	8	12.200	1.235

N = Sample Size
DF = Degrees of Freedom
SS = Sum of Squares
MS = Mean Square
F = F Value

Source: ESE, 1988

5/2/89

($p < 0.05$), between the two contaminated sections ($p < 0.05$), and between control sites as a group and contaminated sections as a group ($p < 0.01$). The only additional information provided by the results of SNK Test is that prairie dogs from contaminated Section 31 and the offsite control exhibited statistically different levels of AChE as well.

2.5.2 COTTONTAIL RABBITS

Rationale

AChE activity in rabbits was evaluated from four sites. The sample size from Section 35 was too small ($N = 1$) for statistical analyses and was combined with data from Section 36 ($N = 7$) to constitute the contaminated group ($N = 8$). Sample sizes from onpost and offpost control sites were sufficiently large (onpost, $N = 11$; offpost, $N = 8$) for statistical purposes, and together with the contaminated site, constituted the three treatment groups. One way ANOVA was conducted to evaluate the existence of mean treatment effects among the three groups. More powerful a priori tests were conducted to compare the two controls to each other, and the combined control sites to the contaminated sites. A posteriori tests were not performed on the data because the more powerful ANOVA failed to detect significant differences among groups.

Results

Table B.2-9 contains the descriptive statistics, the result of Bartlett's Test, and results of the ANOVA and orthogonal a priori tests.

Remarks

Both the ANOVA and a priori comparisons failed to detect any mean differences among treatment groups.

2.5.3 MALLARDS

Rationale

AChE activity in mallards was evaluated from two sites. The samples from all contaminated sites were combined as a single group ($N = 9$) and compared to those from the offpost control ($N = 6$) via a one way ANOVA. Neither a priori nor a posteriori tests were conducted because the number of groups equalled two.

5/3/89

Table B.2-9. Statistical Analysis of AChE Activity in Cottontail Rabbits

Above--One Way ANOVA and Orthogonal A Priori Comparisons of AChE Activity Among 3 Treatment Groups.

Below--Descriptive Statistics; SNK Tests were not Conducted Because the Overall Results of the ANOVA were not Significant.

Source of Variation	DF	SS	MS	F	Significance
Among	2	2.48	1.24	1.10	NS
Control Onpost vs Offpost	1	2.48	2.48	1.10	NS
Control vs Contam.	1	0.00	0.00	0.00	NS
Within	19	21.40	1.13		
Total	21	23.88	1.14		

Bartlett's test of homoscedasticity: $X^2 = 1.575$; DF = 2; P > 0.05.

Treatment	Mean	N	Variance	Standard Error
Contaminated	11.248	8	0.757	0.308
Control				
Onpost	11.733	6	1.958	0.571
Offpost	10.882	8	0.901	0.336

NS = Not Significant with $p > 0.05$

N = Sample Size

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

Source: ESE, 1988.

Results

Table B.2-10 contains the result of the ANOVA as well as descriptive statistics.

Remarks

The ANOVA indicated that evidence for mean differences between contaminated and control groups was not present in the data, the low degrees of freedom ($V = 1.13$) combined with the level of significance ($p = 0.149$) suggest that with larger samples sizes, true differences might be forthcoming.

2.5.4 PHEASANTS

Rationale

ACHe activity in pheasants was evaluated from two sites. The samples from all contaminated sites were combined as a single group ($N = 6$) and compared to those from the offpost control ($n = 7$) via a one-way ANOVA. Neither a priori nor a posteriori tests were conducted because the number of groups equalled two.

Results

Table B.2-11 contains the result of Bartlett's Test for homogeneity of variances, the ANOVA, and descriptive statistics.

Remarks

The ANOVA indicated that evidence for a mean difference between contaminated and control groups was not present in the data.

2.6 PRAIRIE DOG DENSITY

Rationale

Counts of prairie dog density form a total of six different treatment groups constitute the data. In general, two independent factors (season--summer and winter; as well as treatment--contaminated and control) describe each treatment group; however, the sections that constituted the contaminated groups were not the same in both seasons. As a result, two-way ANOVA could not be performed. Nonetheless, a one way ANOVA with a priori contrasts, designed to take into account season and contamination status, provided a powerful method of detecting differences among groups. The first level of

5/3/89

Table B.2-10. Statistical Analysis of AChE Activity in Mallards.

Above--One Way ANOVA of AChE Activity Between Two Treatment Groups (control versus contaminated sites).

Below--Descriptive Statistics.

Source of Variation	DF	SS	MS	F	Significance
Among	1	6.37	6.37	1.99	NS
Within	13	41.56	3.20		
Total	14	47.93	3.42		

Bartlett's test of homoscedasticity: $\chi^2 = 0.480$; DF = 1; P > 0.05.

Treatment	Mean	N	Variance	Standard Error
Contaminated	14.836	9	3.845	0.654
Control	13.505	6	2.160	0.600

NS = Not Significant with $p > 0.05$

N = Sample Size

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

Source: ESE, 1988.

Table B.2-11. Statistical Analyses of AChE Activity in Pheasants

Above--One Way ANOVA of AChE Activity Between Two Treatment Groups (control versus contaminated sites).

Below--Descriptive Statistics.

Source of Variation	DF	SS	MS	F	Significance
Among	1	5.32	5.32	0.70	NS
Within	11	84.02	7.64		
Total	12	89.34	4.45		

Bartlett's test of homoscedasticity: $X^2 = 1.914$; $DF = 1$; $P > 0.05$.

Treatment	Mean	N	Varlance	Standard Error
Contaminated	21.765	6	12.340	1.434
Control	23.079	7	3.720	0.729

NS = Not Significant with $p > 0.05$

N = Sample Size

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

Source: ESE, 1988.

the hierarchical division of groups is between summer and winter census data. Within winter, combined controls (west and east) were compared to central sites (contaminated Plot 21 and 22 plus uncontaminated but adjacent, Plot 24 and 23). Within winter controls, east and west were compared to each other. Within summer, Plots 1, 4, 13, 8, and 9, as a group (Others) were compared to combined controls (east and west). Subsequently, east control and west control sections were compared to each other.

Results

Table B.2-12 contains the results of the ANOVA, orthogonal a priori contrasts, and descriptive statistics.

Remarks

Bartlett's Test indicated that the variances of the treatment groups were homoscedastic. Although the ANOVA suggested no significant differences among the six treatment groups, the more powerful a priori tests were conducted as described in the rationale above. Nonetheless, none of the orthogonal comparisons yielded significant differences, indicating that mean prairie dog densities did not differ among the six sites to any detectable degree beyond chance expectations. A posteriori tests were not conducted because they would be less powerful than the ANOVA (which did not detect any mean group differences).

2.7 AMERICAN KESTREL STUDY

Rationale

American kestrel nesting success was compared between sites (control vs RMA) and among years (1982 vs 1983 vs 1986). Four factors (clutch size, hatchlings per nest, fledgling per successful nest, and fledgling per all nests) were tested. Both parametric and non-parametric statistics were performed.

Results

Table B.2-13 contains the results of the ANOVA, Kruskal-Wallis ANOVA, and a priori contrasts.

Table B.2-12. Statistical Analysis of Prairie Dog Density.

Above--One Way ANOVA and Orthogonal A Priori Comparisons of Prairie Dog Density Among Six Treatment Groups

Below--Descriptive Statistics.

Source of Variation	DF	SS	MS	F	Significance
Among	5	745.6	149.11	1.09	NS
Summer vs Winter	2	124.2	124.22	0.91	NS
Summer					
Control E vs W	1	387.4	387.36	2.84	NS
Control vs Others	1	23.8	23.82	0.18	NS
Winter					
Control E vs W	1	50.0	50.00	0.37	NS
Control vs Central	1	160.2	160.17	1.174	NS
Within	25	3,410.3	136.41		
Total	30	4,155.9	138.53		

Bartlett's test of homoscedasticity: $\chi^2 = 4.354$; DF = 5; P > 0.05.

Treatment	Mean	N	Variance	Standard Error
Summer				
Others	17.600	5	197.300	6.282
Control E	16.222	9	65.694	2.702
Control W	27.200	5	123.700	4.974
Winter				
Central	28.750	4	60.917	3.902
Control E	18.500	4	169.667	6.513
Control W	23.500	4	303.000	8.703

NS = Not Significant with p > 0.05

N = Sample Size

DF = Degrees of Freedom

SS = Sum of Squares

MS = Mean Square

F = F Value

Source: ESE, 1988.

5/3/89

Table B.2-13. Statistical Analysis of American Kestrel Nesting Success.

Analysis/Kestrel	Clutch Size	Hatchling Per Nest	Fledgling per Success Nest	Fledgling per All Nest
ANOVA:				
Source				
Between Sites (S)	NS	NS	NS	@
Among Gores (Y)	NS	*	NS	**
S x Y	NS	NS	NS	NS
A priori (PARAMETRIC)				
82-Control vs. RMA	NS	NS	NS	NS
83-Control vs. RMA	NS	NS	NS	*
86 Control vs. RMA	NS	NS	NS	NS
82 vs. 83 vs. 86	NS	*	NS	*
K-W ANOVA: Source				
Among site-yr combos	NS	@	NS	*
A priori (NONPARAMETRIC)				
82-Control vs. RMA	NS	NS	NS	NS
83-Control vs. RMA	NS	NS	NS	*
86 Control vs. RMA	NS	NS	NS	NS
82 vs. 83 vs. 86	NS	*	NS	*

NS = Not Significant.

* = $p < 0.05$.** = $p < 0.01$ @ = Near Significant ($0.100 > p > 0.050$)

3.0 STATISTICAL ANALYSES FOR AQUATIC CONTAMINANTS

3.1 RATIONALE

The objectives of the RMA aquatic biota investigations in 1986 were to test for contaminant differences among RMA lakes, among aquatic species, and among tissue types within species. In 1988, objectives were similar except that samples were taken from only one RMA lake, Lower Derby Lake, and compared with samples taken from one offsite lake, McKay Lake. Lower Derby Lake was chosen as representative of RMA lakes based on the findings of the 1986 studies.

Two approaches were used in the statistical analyses of the aquatic data. The first emphasized comparing differences among lakes and among fish species using strictly orthogonal (i.e., non-overlapping) data sets. These tests are referred to in the text as "primary tests." The second approach focused upon exploring for differences among many combinations of lakes, species, and tissue types. To accomplish this, numerous pair-wise comparisons were performed. These tests are referred to in the text as "secondary tests." Problems with the second approach involved smaller sample sizes and a lack of independence among some tests. As an example of the latter, data for fillets and remains of bass in McKay Lake (1988) were used both for comparisons between McKay Lake and Lower Derby Lake, and between fillets and remains within McKay Lake.

A nonparametric approach was used as the principal basis for assessing statistical differences because of the greater generality provided by nonparametric test (compared to parametric tests) and:

- o To avoid problems of well-documented heteroscedasticity in the data (including where treatment cells have zero variance because all samples are below the CRL);
- o To avoid questions of assignment of numerical values to below CRL situations which could introduce bias in parametric tests but not in nonparametric tests based on ranks (i.e., all below CRL values would be tied at the lowest rank in KW tests); and
- o To avoid criticism of treatment cells which appear markedly non-normal.

In the majority of cases (13 of 16 tests) the data were either heteroscedastic ($p < 0.05$) or a treatment cell had zero variance. Homoscedasticity was observed in three cases, but the power was low due to the small sample sizes. Although primary tests comprise both parametric and nonparametric approaches, consistently significant heteroscedasticity, treatment cells with zero variance, and small sample sizes with non-normal appearing distributions argue for reliance on the nonparametric results. The Kruskal-Wallis nonparametric ANOVA has a 95% asymptotic power efficiency compared to the parametric test (when its assumptions are valid), and the levels of significance for both approaches are similar throughout. As a result, "primary tests" hereafter only refer to the nonparametric results.

In addition, both the 90 percent and 95 percent rejection levels were considered when interpreting the results. The 95 percent level ($p < 0.05$) is referred to in this report as being "significant," while the 90 percent level ($0.05 < p < 0.1$) is said to be "approaching significance." F_{\max} tests of homoscedasticity were performed for all analyses.

3.2 RESULTS AND DISCUSSION

Descriptive statistics (mean, standard error, and sample size) for all tests rejecting null hypotheses are shown in Table B.3-1. Tables B.3-2 through B.3-8 present primary tests, including significant and nonsignificant results. Tables B.3-9 through B.3-11 present secondary tests, for significant results only. Tables B.3-12 through B.3-14 present additional secondary tests with only nonsignificant results.

Sample sizes of the treatment groups varied from two to six; as a result, statistical power was low. Large group differences are required to produce significant analyses. In many cases, a lack of significance may be an artifact of sample size rather than an indicator of no treatment effect. Inconsistent (or nonparallel) data collection between levels of the possible treatment factors (years, lakes, species, tissues) also prevents many questions concerning the effects of contamination from being answered in a satisfactory manner.

Table B.3-1. Descriptive statistics (mean, standard error, and sample size) for analytes (A, mercury; B, dieldrin; and C, DDE) involved in previous statistical analyses.

LAKE	BLUEGILL			LARGEMOUTH BASS			NORTHERN PIKE		
	WHOLE	REMAIN	FILLET	WHOLE	REMAIN	FILLET	WHOLE	REMAIN	FILLET
A. MERCURY									
DEBBY_(1986)									
MEAN	0.050			0.054			0.406		
S.E.	0.000			0.004			0.064		
N	3			3			3		
LADORA_(1986)									
MEAN	0.084			0.182			0.330		
S.E.	0.020			0.049			0.040		
N	2			3			3		
MARY_(1986)									
MEAN	0.074		0.083	0.074		0.075			
S.E.	0.014		0.016	0.015		0.025			
N	6		3	3		2			
DERBY_(1988)									
MEAN	0.063			0.250		0.359			
S.E.	0.007			0.025		0.062			
N	6			5		5			
MCKAY_(1988)									
MEAN	0.050	0.109	0.188	0.084		0.152			
S.E.	0.000	0.022	0.030	0.011		0.023			
N	2	5	5	5		5			

5/3/89

Table B.3-1 (continued)

LAKE	BLUEGILL			LARGEMOUTH BASS			NORTHERN PIKE		
	WHOLE	REMAIN	FILLET	WHOLE	REMAIN	FILLET	WHOLE	REMAIN	FILLET
B. DIELDRIN									
DERBY_(1986)									
MEAN	0.149			0.077					0.031
S.E.	0.006			0.024					0.000
N	3			3					3
LADORA_(1986)									
MEAN	0.100			0.032					0.038
S.E.	0.027			0.001					0.007
N	3			3					2
MARY_(1986)									
MEAN	0.088		0.034	0.059		0.031			
S.E.	0.019		0.003	0.028		0.000			
N	6		3	3		2			
DERBY_(1988)									
MEAN	0.070			0.375	0.486	0.218			
S.E.	0.016			0.097	0.132	0.060			
N	6			5	5	5			
MCKAY_(1988)									
MEAN	0.031	0.031	0.031		0.031	0.031			
S.E.	0.000	0.000	0.000		0.000	0.000			
N	2	5	5		5	5			

Table B.3-1 (continued)

LAKE	BLUEGILL			LARGEMOUTH BASS			NORTHERN PIKE		
	WHOLE	REMAIN	FILLET	WHOLE	REMAIN	FILLET	WHOLE	REMAIN	FILLET
C. DDE									
DERBY (1988)									
MEAN	0.094			0.593	0.329				
S.E.	0.000			0.152	0.101				
N	6			5	5				
MCKAY (1988)									
MEAN	0.094	0.094	0.094	0.094	0.094				
S.E.	0.000	0.000	0.000	0.000	0.000				
N	2	5	5	5	5				
D. ALDRIN ²									
DERBY (1988)									
MEAN	0.020			0.020	0.033	0.005			
S.E.	0.000			-----	0.006	0.005			
N	5			1	5	5			
MCKAY (1988)									
MEAN	0.020	0.020	0.020	0.020	0.020				
S.E.	0.000	0.000	0.000	0.000	0.000				
N	2	5	5	5	5				

¹ Values for whole tissue samples of Mercury in 1988 for Bass in Lake McKay, and Bluegill in Lake McKay were reconstituted samples.

² Although data were collected on DDE in 1986, all sample values were the CRL (0.094) except for the single Bullhead from Lower Derby (whole tissue) regardless of lake, species, or tissue type. No statistical tests were performed on these data and descriptive statistic were similarly not reported in tabular form since sample means (0.094) and sample standard errors (0.000) would be equal.

³ Although data were collected on aldrin in 1986, all sample values were the CRL (0.020) regardless of lake, species, or tissue type. No statistical tests were performed on these data and descriptive statistic were similarly not reported in tabular form since sample means (0.020) and sample standard errors (0.000) would be equal.

Table B.3-2 Results of one-way (Lake Derby versus Ladora) parametric and nonparametric (Kruskal-Wallis one-way analysis of variance by ranks = KW) ANOVA on analytes (A, mercury; and B, dieldrin) for pike fillets in 1986.

SOURCE	DF	MS	F	SIGNIFICANCE	K-W	SIGNIFICANCE
A. MERCURY						
LAKE	1	0.007	0.749	0.451	0.351	0.554
WITHIN	3	0.009				
TOTAL	4					
B. DIELDRIN						
LAKE	1	0.000	1.800	0.259	1.500	0.221
WITHIN	3	0.000				
TOTAL	4					

DF - Degrees of Freedom
MS - Mean Square

5/3/89

Table B.3-3 Results of one-way (bluegill versus largemouth bass) parametric and nonparametric (Kruskal-Wallis one-way analysis of variance by ranks = KW) ANOVA on analytes (A, mercury; and B, dieldrin) for Lake Mary fillets in 1986.

SOURCE	DF	MS	F	SIGNIFICANCE	K-W	SIGNIFICANCE
A. MERCURY						
SPECIES	1	0.000	0.063	0.818	0.093	0.761
WITHIN	3	0.001				
TOTAL	4					
B. DIELDRIN						
SPECIES	1	0.000	0.600	0.495	0.667	0.414
WITHIN	3	0.000				
TOTAL	4					

DF - Degrees of Freedom

MS - Mean Square

5/3/89

Table B.3-4 Results of one-way (remains versus fillets) parametric and nonparametric (Kruskal-Wallis one-way analysis of variance by ranks = KW) ANOVA on analytes (A, mercury; B, dieldrin; and C, DDE) for bluegill from Lake McKay in 1988.

SOURCE	DF	MS	F	SIGNIFICANCE	K-W	SIGNIFICANCE
A. MERCURY						
TISSUE	1	0.016	4.523	0.067	3.153	0.076 @
WITHIN	8	0.003				
TOTAL	9					
B. DIELDRIN						
TISSUE	1	0.000	-----	1.000	0.000	1.000
WITHIN	8	0.000				
TOTAL	9					
C. DDE						
TISSUE	1	0.000	-----	1.000	0.000	1.000
WITHIN	8	0.000				
TOTAL	9					

DF - Degrees of Freedom

MS - Mean Square

@ - Near Significance ($0.100 > p > 0.050$)

Table B.3-5. Results of two-way (lakes -- Derby versus Ladora versus McKay; species -- largemouth bass versus bluegill) parametric ANOVA (including a priori tests) and hierarchical nonparametric Kruskal-Wallis one-way ANOVA by ranks (KW) on analytes (A, mercury; B, dieldrin) for whole tissue samples in 1986.

SOURCE	DF	MS	F	P	K-W	P
A. MERCURY						
GROUPS	5	0.007	4.318	0.012		
LAKES WITHIN BASS	2	0.014	8.400	0.001		
LAKES WITHIN BLUEGILL	2	0.001	0.600	0.550		
BASS VERSUS BLUEGILL	1	0.006	3.600	0.070		
LAKES (L)	2	0.011	6.552	0.009		
SPECIES (S)	1	0.005	2.961	0.096		
L X S	2	0.005	2.964	0.082		
WITHIN	15	0.002				
GROUPS					9.948	0.077 @
LAKES WITHIN BASS					5.241	0.073 @
LAKES WITHIN FILLETS					4.403	0.132
LARGEMOUTH BASS VERSUS BLUEGILL					1.437	0.487
B. DIELDRIN						
GROUPS	5	0.005	2.927	0.049		
LAKES WITHIN BASS	2	0.002	1.250	0.140		
LAKES WITHIN BLUEGILL	2	0.004	2.500	0.120		
BASS VERSUS BLUEGILL	1	0.013	8.125	0.010		
LAKES (L)	2	0.004	2.233	0.142		
SPECIES (S)	1	0.014	8.918	0.009		
L X S	2	0.001	0.626	0.548		
WITHIN	15	0.002				
GROUPS					8.667	0.123
LAKES WITHIN BASS					0.461	0.794
LAKES WITHIN FILLETS					3.103	0.212
LARGEMOUTH BASS VERSUS BLUEGILL					5.284	0.071 @

DF - Degrees of Freedom

MS - Mean Square

@ - Approaches significance (0.100 > p > 0.050)

Table B.3-6 Results of two-way (lakes -- Derby versus McKay; tissues -- remains versus fillets) parametric ANOVA and hierarchical nonparametric Kruskal-Wallis one-way ANOVA by ranks (KW) on analytes (A, mercury; B, dieldrin; C, DDE; D, aldrin) for largemouth bass in 1988.

SOURCE	DF	MS	F	SIGNIFICANCE	K-W	SIGNIFICANCE
A. MERCURY						
GROUPS	3	0.072	11.143	0.000		
LAKES (L)	1	0.174	27.038	0.000		
TISSUES (T)	1	0.039	6.071	0.026		
L X T	1	0.002	0.322	0.578		
WITHIN	16	0.006				
					14.657	0.002 **
GROUPS					6.818	0.009 **
BETWEEN LAKES WITHIN REMAINS					5.741	0.016 *
BETWEEN LAKES WITHIN FILLETS					2.286	0.131
FILLETS VERSUS REMAINS						
B. DIELDRIN						
GROUPS	3	0.295	8.321	0.001		
LAKES (L)	1	0.616	17.367	0.001		
TISSUES (T)	1	0.135	3.798	0.072		
L X T	1	0.135	0.135	3.798		
WITHIN	16	0.567				
					15.234	0.002 **
GROUPS					7.759	0.005 **
BETWEEN LAKES WITHIN REMAINS					5.538	0.019 *
BETWEEN LAKES WITHIN FILLETS					0.685	0.408
FILLETS VERSUS REMAINS						
C. DDE						
GROUPS	3	0.885	8.321	0.001		
LAKES (L)	1	0.674	16.165	0.001		
TISSUES (T)	1	0.087	2.095	0.136		
L X T	1	0.087	2.095	0.136		
WITHIN	16					
					14.657	0.002 **
GROUPS					6.818	0.009 **
BETWEEN LAKES WITHIN REMAINS					5.741	0.016 *
BETWEEN LAKES WITHIN FILLETS					2.286	0.131
FILLETS VERSUS REMAINS						

Table B.3-6 (continued)

SOURCE	DF	MS	F	SIGNIFICANCE	K-W	SIGNIFICANCE
D. ALDRIN						
GROUPS	3	0.00020	2.728	0.078		
LAKES (L)	1	0.00420	5.666	0.031		
TISSUES (T)	1	0.00009	1.260	0.156		
L X T	1	0.00009	1.260	0.156		
WITHIN	16	0.00007				
					10.038	0.018 *
GROUPS					5.538	0.019 *
BETWEEN LAKES WITHIN REMAINS					1.000	0.371
BETWEEN LAKES WITHIN FILLETS					1.935	0.164
FILLETS VERSUS REMAINS						

DF - Degrees of Freedom

MS - Mean Square

* - Significant ($p < 0.05$)

** - Highly significant ($p < 0.01$)

ble B.3-7. ABOVE Results of two-way (lakes--Derby versus McKay; species--Largemouth Bass versus Bluegill) parametric ANOVA (including a priori tests) and hierarchical nonparametric Kruskal-Wallis one-way ANOVA by ranks (KW) on mercury for whole tissue samples in 1988. BELOW--Results of one-way (Lake Derby versus Lake McKay) parametric and nonparametric (Kruskal-Wallis one-way ANOVA by ranks = KW) ANOVA on dieldrin and DDE for whole tissues in 1988.

SOURCE	DF	MS	F	SIGNIFICANCE	K-W	SIGNIFICANCE
A. MERCURY						
GROUPS		3	0.045	11.250	0.000	
LAKES WITHIN BASS	1	0.074	19.923	0.000		
LAKES WITHIN BLUEGILL	1	0.000	2.243	0.130		
BASS VERSUS BLUEGILL	1	0.053	14.269	0.001		
LAKES (L)	1	0.015	3.981	0.620		
SPECIES (S)	1	0.053	14.236	0.001		
L X S	1	0.068	18.226	0.000		
WITHIN	21	0.004				
GROUPS					14.162	0.003**
LAKES WITHIN BASS					6.587	0.010**
LAKES WITHIN BLUEGILL					2.613	0.106
BASS VERSUS BLUEGILL					6.311	0.102*
B. DIELDRIN						
LAKES	1	0.002	1.801	0.201	2.018	0.155
WITHIN	6	0.001				
TOTAL	7					
C. DDE						
TISSUE	1	0.000	-----	1.000	0.000	1.000
WITHIN	6	0.000				
TOTAL	7					

* DF = Degrees of Freedom
MS = Mean Square
F = one-way ANOVA results
P = significance of F to t-test results
KW = Kruskal-Wallis results
P(KW) = significance of Kruskal-Wallis results

Table B.3-8. Statistical comparisons of species, lakes, and tissues. Tests are two-way ANOVAs and nonparametric Kruskal-Wallis.*

1. SOURCE	DF	MS	F	P	P(KW)
Mercury 1986 Whole-Body:					
Ladora, Mary	1	0.012	5.011	0.071	0.213
Bass, Bluegill	1	0.009	3.639	0.069	0.271
Lake by Species	1	0.006	2.391	0.121	0.340
Within	8	0.002			
2. SOURCE	DF	MS	F	P	P(KW)
Mercury 1988 McKay:					
Filletts, Remains	1	0.027	10.681	0.005	0.006
Bass, Bluegill	1	0.005	1.814	0.197	0.293
Tissue by Species	1	0.000	0.062	0.807	0.859
Within	16	0.003			
3. SOURCE	DF	MS	F	P	P(KW)
Dieldrin 1986 Whole-Body:					
Derby, Ladora, Mary	2	0.004	3.258	0.052	0.138
Bass, Bluegill	1	0.012	9.245	0.009	0.013
Lake by Species	2	0.001	1.103	0.269	0.609
Within	12				

* DF = degrees of freedom
 MS = mean square
 F = one-way ANOVA results
 P = significance of F
 P(KW) = significance of Kruskal-Wallis results

04/11/89

Table B.3-9. Statistical comparisons among lakes. Tests are parametric ANOVA, t-tests, and nonparametric Kruskal-Wallis.*

1. Lakes: Ladora versus Derby versus Mary
Means and sample sizes: 0.182(3) 0.054(3) 0.074(3)

<u>SOURCE</u>	<u>DF</u>	<u>MS</u>	<u>F</u>	<u>P</u>	<u>KW</u>	<u>P(KW)</u>
Mercury 1986						
Bass, Whole-body	2	0.014	5.355	0.046	5.241	0.073
Within	6	0.003				

2. Lakes: Derby versus McKay
Means and sample sizes: 0.359(5) 0.152(5)

<u>SOURCE</u>	<u>t</u>	<u>P</u>	<u>KW</u>	<u>P(KW)</u>
Mercury 1988				
Bass, Fillets	3.122	0.014	5.771	0.016

3. Lakes: Derby versus McKay
Means and sample sizes: 0.250(5) 0.084(5)

<u>SOURCE</u>	<u>t</u>	<u>P</u>	<u>KW</u>	<u>P(KW)</u>
Mercury 1988				
Bass, Remains	6.040	0.000	6.818	0.009

Source: MKE, 1988.

- * DF = degrees of freedom
MS = mean square
F = one-way ANOVA results
t = t-test results
P = significance of F or t-test results
KW = Kruskal-Wallis results
P(KW) = significance of Kruskal-Wallis results

Table B.3-10. Statistical comparisons among species. Tests are parametric t-tests and nonparametric Kruskal-Wallis.*

1. Species: Bass versus Bluegill**
Means and sample sizes: 0.294(5) 0.063(6)

<u>SOURCE</u>	<u>t</u>	<u>P</u>	<u>KW</u>	<u>P(KW)</u>
Mercury 1988				
Whole-body, Derby	7.304	0.000	7.639	0.006
Within				

2. Species: Bass versus Bluegill
Means and sample sizes: 0.375(5) 0.070(6)

<u>SOURCE</u>	<u>t</u>	<u>P</u>	<u>KW</u>	<u>P(KW)</u>
Dieldrin 1988				
Whole-body, Derby	3.425	0.008	4.822	0.028
Within				

3. Species: Bass versus Bluegill
Means and sample sizes: 0.032(3) 0.100(3)

<u>SOURCE</u>	<u>t</u>	<u>P</u>	<u>KW</u>	<u>P(KW)</u>
Dieldrin 1986				
Whole-body, Ladora	2.509	0.066	3.857	0.050
Within				

Source: MKE, 1988.

- * DF = degrees of freedom
MS = mean square
F = one-way ANOVA results
t = t-test results
P = significance of F or t-test results
KW = Kruskal-Wallis results
P(KW) = significance of Kruskal-Wallis results

** In test No. 1, bass data are from five reconstructed whole-body samples.

04/11/89

Table B.3-11. Statistical comparisons among tissue types. Tests are parametric t-tests and nonparametric Kruskal-Wallis.*

1. Tissues:		Filletts versus Remains		
Means and sample sizes:		0.152(5)	0.084(5)	
<u>SOURCE</u>	<u>t</u>	<u>P</u>	<u>KW</u>	<u>P(KW)</u>
Mercury 1988				
Bass, McKay	2.684	0.028	5.771	0.016
Within				
2. Tissues:		Filletts versus Whole-Bodies		
Means and sample sizes:		0.034(3)	0.088(6)	
<u>SOURCE</u>	<u>t</u>	<u>P</u>	<u>KW</u>	<u>P(KW)</u>
Dieldrin 1986				
Bluegill, Mary	1.886	0.101	2.483	0.115
Within				
3. Tissues:		Filletts versus Remains		
Means and sample sizes:		0.218(5)	0.486(5)	
<u>SOURCE</u>	<u>t</u>	<u>P</u>	<u>KW</u>	<u>P(KW)</u>
Dieldrin 1988				
Bass, Derby	1.849	0.102	2.455	0.117
Within				
4. Tissues:		Filletts versus Remains		
Means and sample sizes:		0.188(5)	0.109(5)	
<u>SOURCE</u>	<u>t</u>	<u>P</u>	<u>KW</u>	<u>P(KW)</u>
Mercury 1988				
Bluegill, McKay	2.137	0.065	3.153	0.076
Within				
Total				

Source: MKE, 1983.

- * DF = degrees of freedom
- MS = mean square
- F = one-way ANOVA results
- t = t-test results
- P = significance of F or t-test results
- KW = Kruskal-Wallis results
- P(KW) = significance of Kruskal-Wallis results

04/11/89

Table B.3-12. Nonsignificant comparisons among RNA lakes. Tests are parametric ANOVA.¹

Tissue Type ²	Analyte	Lower Derby	Lake Ladora	Lake Gary	P
Bluegill (w) 1986	Dieldrin	.149 (.161)	.100 (.153)	.088 (.107)	P = 0.17
Bluegill (w) 1986	Mercury		.084 (.124)	.074 (.137)	P > 0.50
Largemouth Bass (w) 1986	Dieldrin	.077 (.112)	.032 (.034)	.059 (.115)	P > 0.10
Northern Pike (f) 1986	Mercury	.406 (.470)	.330 (.370)		P = 0.50

¹ Data are mean tissue concentrations in ug/g; maximum values are shown in parentheses.

² w = whole body; f = fillet; r = remains (whole body minus fillets).

Source: MKE, 1988.

04/12/89

Table B.3-13. Nonsignificant comparisons among species. Tests are parametric ANOVA.¹

Tissue Type ²	Lake	Contaminant	Black Bullhead	Bluegill ³	Largemouth Bass
1988 whole body	Lower Darby	Dieldrin	.144 (.209)	.149 (.161)	.077 (.112)
whole body	Lower Darby	Mercury	.051 (.051)		.054 (.063)
whole body	Lake Ladara	Mercury		.084 (.124)	.182 (.235)
whole body	Lake Mary	Dieldrin		.086 (.134)	.059 (.115)
whole body	Lake Mary	Mercury		.074 (.137)	.072 (.101)
1988 whole body	McKay	Mercury		.141 (.178)	.109 (.157)
fillet	McKay	Mercury		.188 (.255)	.152 (.236)
remains	McKay	Mercury		.109 (.171)	.084 (.119)

- ¹ Data are mean tissue concentrations in ppm; the maximum value is shown in parenthesis.
² Pair-wise comparisons of fillets for 1988 and whole bodies for 1988 were not possible because of non-analogous data sets.
³ Values in brackets indicate whole-body data obtained by re-combining fillet and remains data on a biomass-weighted basis.

Source: MRE, 1988.

Table 3.3-11. Nonsignificant comparisons among tissue types. Tests are parametric ANOVA.¹

Species, Year	Lake	Contaminant	$\frac{w}{f}^2$	$\frac{f}{w}^2$	$\frac{f}{w}^2$
Bluegill, 1986	Lake Mary	Mercury	.074 (.137)	.083 (.099)	P > 0.50
Lacemouth Bass, 1986	Lake Mary	Mercury	.074 (.101)	.076 (.101)	P > 0.50
Lacemouth Bass, 1988	Lower Darby	Aldrin		.025 (.044)	P = 0.25
Lacemouth Bass, 1988	Lower Darby	DDE		.329 (.604)	P > 0.10
Lacemouth Bass, 1988	Lower Darby	Mercury		.359 (.550)	P > 0.10

¹ Data are mean tissue concentrations in ppm; the maximum value is shown in parenthesis.

² w = whole body; f = fillet; f = remaria (whole body minus fillets).

Source: WRE, 1988.

3.2.1 DATA FROM 1986 AQUATIC STUDIES

Three separate analyses were performed on analyte data. Each analysis was conducted separately for mercury and dieldrin. The results of each analysis appear in Tables B.3-2, B.3-3, and B.3-5, while the discussion of each table follows and is based upon the nonparametric results. No significant differences were found between onpost and control lakes or between species in the lakes for any of the contaminants which were analyzed.

3.2.2 DATA FROM 1988 AQUATIC STUDIES

Three separate analyses were performed on analyte data. Each analysis was conducted separately for mercury, dieldrin, aldrin, and DDE. The results of each analysis appear in Tables B.3-4, B.3-6, and B.3-7, while the discussion of each table follows and is based upon the nonparametric results.

Table B.3-6 presents the differences among combinations of lakes (Derby versus McKay) and tissues (remains versus fillets), holding species (bass) and year (1988) constant.

Mercury. The significant differences among the four treatment groups in the preliminary KW is primarily caused by consistent significant differences between Derby and McKay lakes regardless of tissue type. No significant difference between tissue types was detected when the lakes samples were pooled.

Dieldrin. The significant differences among treatment groups in the preliminary KW is primarily caused by consistent significant differences between Derby and McKay lakes regardless of tissue type. No significant difference between tissue types was detected when the lakes samples were pooled.

DDE

The significant difference among treatment groups in the preliminary KW is primarily caused by consistent significant differences between Derby and McKay lakes regardless of tissue type. No significant difference between tissue types was detected when the lakes samples were pooled.

Aldrin

The significant difference among treatment groups in the preliminary KW is primarily caused by a significant difference between Derby and McKay lakes in samples of remains. No significant differences occurred between lakes in samples of fillets or between tissue types when lake samples were pooled.

Table B.3-7 presents the differences between lakes (Derby versus McKay) holding species (bluegill), tissue (whole) and year (1988) constant. No significant difference between lakes was detected for mercury, dieldrin, or DDE.

Table B.3-4 presents the differences between tissues (remains versus fillets) holding lake (McKay), species (bluegill), and year (1988) constant.

Mercury

Significance was approached for differences between tissues.

Dieldrin

No difference was detected between tissues: all samples for both tissue types were at the CRL.

DDE and Aldrin

No difference was detected between tissues: all samples for both tissue types were at the CRL.

3.3 CONCLUSIONS

The most important and informative comparisons from the point-of-view of the effects of contamination at RMA on the biota are those that involve comparisons of sites in which at least one contaminated and one control lake exist. MKE do not provide these data for 1986. Two of the statistical analyses (Tables B.3-6 and B.3-7) for 1988 do permit evaluation of the question as to whether biota in a contaminated lake (Derby) exhibit analyte concentrations that are distinguishable from those in a control lake.

Nonetheless, sample sizes in both cases are small and real differences may be missed because of low power. Moreover, comparisons that involved a single control lake and a single onsite lake may represent false replication in that "all other features of the lakes are not equal," making interpretation of significance or nonsignificance difficult. Each of the four (mercury, dieldrin, DDE, aldrin) contaminants exhibited highly significant differences between RMA and control lakes for bass despite small sample sizes. None of the analytes exhibited significant differences between control (N = 2) and RMA (N = 6) lakes for bluegill (whole tissue), at least in part because of small samples. Additional comment on tests or comparisons that do not directly involve control and contaminated lakes are not made herein.

REFERENCES

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- Sokal, R.R., and F.J. Rohlf. 1981. Biometry. Second Edition. Freeman and Company. San Francisco, California.

LITERATURE REVIEW
THE USE OF PESTICIDES AND HERBICIDES
BY THE ARMY FOR THE CONTROL OF PESTS
AND VEGETATION AT ROCKY MOUNTAIN ARSENAL

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OCTOBER 1988

EXECUTIVE SUMMARY

This report presents the results of an in-depth survey of all available extant literature on the use by the Army of chemical pesticides and herbicides for pest and vegetation control at Rocky Mountain Arsenal between 1943 and 1987. The literature on this subject while voluminous is fragmentary and/or non-existent in strategic areas. This situation effectively precludes a reconstruction of Army pest and vegetation control operations on a site-specific basis. Meaningful quantification of historical herbicide and pesticide usage is similarly impossible. In consequence, this report takes the form of an Arsenal-wide narrative, chronicling to the extent possible the Army experience in this area. The report covers only Army activities. The requisite documents and records, necessary to a reconstruction of the record of Shell Chemical Co. and its predecessor, the Julius Hyman Co., in the area of pest and vegetation control have as yet not been released. Bibliographies of the extant literature on pest and vegetation control activities and herbicide and pesticide usage are presented on pages 38 to 66 and Appendix D.

**Use of Pesticides and Herbicides
for the Control of Pests and Vegetation at
Rocky Mountain Arsenal**

Since 1943, the Army has conducted a series of ongoing programs for the control of pests and vegetation at Rocky Mountain Arsenal. Over the years, programmatic efforts have concentrated on the removal of weeds and vegetation from railroad tracks, canals and creeks, the control of aquatic vegetation and mosquitoes in the process water storage lakes and the eradication of various pests inhabiting the general area of sites occupied by administrative and living quarters, and production and storage facilities (Deputy, 1985; Donnelly, 1985; Green, 1985; Heim, 1985; Lynes, 1985; Wright, 1985; Donnelly, 1986; Mitchell, 1986, pp. 554-554). Integral to the implementation of these programs for pest and vegetation control has been the extensive utilization of a wide variety of chemical herbicides and pesticides. Available information suggests that herbicides and pesticides were transported to the Arsenal in bulk and mixed on-site to use-proportions in so-called "herbicide and pesticide shops" (Mitchell, 1986, pp. 562-564). The usual practice was to transfer bulk concentrate from a drum to a sprayer tank. The desired solution was then attained by adding either water or kerosine (Lynes, 1985, pp. 79-81). At various times during the active period of the Arsenal's history, Buildings 616, 627B and 643 were used for bulk storage of herbicides and pesticides (USAEHA, 1979; Grodt, 1988; Donnelly, 1986; Mitchell, 1986, p. 628). The first "herbicide and pesticide shop," Building 646, was a temporary structure relocated from GB Plants Area in 1952 (RMA, 1952a; RMA, 1952c, p. 2; RMA, 1953a; Donaghe, 1980). By the mid-1950s, Building 646 had been replaced by a permanent facility, Building 544, constructed in 1953 (DOA, 1953; Parsons, 1957; COE, 1984; Mitchell, 1986, pp. 562-563). Building 544 was operated as the designated "herbicide and pesticide shop" at the Arsenal until

supplanted in the early 1980's by Building 742 (Mitchell, 1986, pp. 562-564). Apparently, little, if any relationship existed between the Army's pest and vegetation control programs, and the herbicide and pesticide manufacturing operations conducted by various lessees of the Army between 1947 and 1982. The individual compounds were, for the most part, different, and as well as can be determined, the Army purchased its bulk herbicide and pesticide stocks from sources off-site (Deputy, 1985; Donnelly, 1985; Green, 1985; Heim, 1985; Lynes, 1985; Wright, 1985; Donnelly, 1986; Mitchell, 1986). Regarding the pest and vegetation control activities conducted by the various lessees, most notably, Julius Hyman & Co. and Shell Chemical Co., in their respective leasehold areas, virtually nothing is known.

In August 1943, the Army began treating the South Lakes with crystalline copper sulfate (Blue Vitriol) to control the growth of algae. Row boats were used to spread the chemical near the surface of the water. The average dosage was between 2.5 and 3.0 pounds of copper sulfate per million gallons of water. On September 30, 1943, three hundred pounds of copper sulfate were mixed in Building 374 and allowed to flow through the baffle flume into Lake Ladora. This method proved ineffective, and subsequent applications of copper sulfate in August 1944 and July 1945 followed the surface treatment method described above (CWS, 1945).

On May 22, 1944, the Arsenal's industrial hygiene and sanitation committee recommended spraying either Paris Green¹ or oil on the seepage pond near Sixth Avenue south of Derby Lake and on the stagnant water holes on "E" Street between Sixth and Seventh Avenues to prevent mosquitoes from breeding (Shaw et al., 1944). In late November 1944, the Army began using rat poison and traps

¹ A poisonous, bright green powder, $(\text{CuO})_3\text{As}_2\text{O}_3 \cdot \text{Cu}(\text{C}_2\text{H}_3\text{O}_2)_2$, used as an insecticide.

to exterminate field mice and rats on the Arsenal (Holaday et al., 1944).

As of April 20, 1945, for the purpose of eradicating flies, mosquitoes and other insects, DDT had been sprayed in various parts of the Arsenal including the pyrotechnic incendiary branch, the service branch, and the Building T-157 barracks. At this time, the industrial hygiene committee of the Arsenal also recommended that the post engineer responsible for the insecticide program apply DDT in all barracks, cafeterias, dispensaries, and mess halls to control bedbugs, cockroaches, and flies (Mnookin et al., 1945).

During May 1946, a large number of gnats and mosquitoes were adversely affecting Army personnel working in the Toxic Storage Yard in Section 6. In response, the industrial hygiene committee recommended spraying DDT insecticide in the South Lakes area to control mosquito and gnat breeding. In previous years, the breeding of these insects had been sufficiently controlled by the variation of water levels in the South Lakes (McLaughlin et al., 1946a). By July 17, 1946, the Army had completed the spraying of DDT on the screens of all the cafeterias, mess halls, and staff houses on the Arsenal (McLaughlin et al., 1946b).

In late March 1947, the industrial hygiene committee recommended that the post engineer spread oil all stagnant ponds, particularly the seepage area west of Ladora Lake, to control flies and mosquitoes (McLaughlin, 1947). On May 6, 1948, the post surgeon directed the spraying of DDT insecticide on apartment and house screens to decrease flies. The surgeon also indicated that the land around these apartments would be sprayed with DDT to control fleas (Harbaugh, 1948).

Army usage of DDT at the Arsenal continued throughout the decade of the 1950s and extended into the 1960s. Available records suggest that on the average three 55-gallon drums of DDT were purchased by the Army annually. During the mosquito season, DDT was sprayed around the South Lakes, connecting water and ditch ways, and picnic areas approximately twice a week. A motor-driven fogger mounted on a two-wheel trailer was used to widen the area of application, facilitating the spraying operation (Lynes, 1985, p. 62; Mitchell, 1986, pp. 555-558).

In 1948, Julius Hyman and Company leased Buildings 633 and 633A located in the southeastern quarter of Section 4 of the Arsenal. Hyman used these structures along with Building 633B, a Hyman-owned building, as a laboratory designed to test insecticides on flies and other insects (Silber, 1948; Goodall, 1953; Atchley and Kent, 1954; Silber, 1954). In 1952, with the acquisition of Hyman's lease, Shell Chemical Company assumed occupancy of these buildings. Between 1953 and 1957, Shell Development Company, an affiliated Shell company, used these buildings, also known as the "bug lab," for agricultural research and bioassay purposes (Goodall, 1953; Shadle, 1953; Silber, 1955; Silber, 1957; Parsons, 1957; Mitchell, 1986, pp. 644-645). The extent of laboratory operations in these facilities is unknown.

In January 1949, the post engineer prepared a land management plan to serve as a guide for the utilization and maintenance of all lands at Rocky Mountain Arsenal. For the purposes of land management, the Arsenal was divided into three distinct areas. In one of these areas, the plan specified the application of "weed control chemicals" to control weeds on bluegrass lawns.² Herbi-

² The selected area covered 913 acres and was considered an intensive use area. It contained the administration and manufacturing areas, shops and warehouses, officers' quarters, and the sewage treatment plant (Unauthored, 1949).

cides and soil sterilizing chemicals were to be used to control vegetation along the Arsenal's railroad tracks (Unauthored, 1949).

During the spring of 1950, the Army announced its intention to use 2,4-D (2,4-dichlorophenoxyacetic acid) to control weeds at the Arsenal. Pests were to be controlled with Chlordane³ insecticide (Chemical Corps, 1950).

In July 1951, Julius Hyman and Company began treating Lake Ladora to control the growth of algae. Hyman performed routine maintenance work on the Arsenal's water system as part of its lease obligations (Silber, 1953a). On August 18, 1953, Hyman informed the Army that "chemical eradication" would be required to control the heavy weed growth in Lake Ladora (Silber, 1953b). Several years later, in July 1958, Shell Chemical Corporation notified the Army that it had "recently completed treatment of the lower lake" to control weeds and algae (Hughes, 1958). Shell continued to treat and control aquatic vegetation in Lake Ladora until at least 1969 (Williams, 1964; Howard, 1969). Unfortunately, the types and quantities of vegetation control of chemicals used by Hyman and Shell during this period are unknown.

In 1952, the Army conducted an insecticide-filling program for the United States Forest Service. Two insecticides, ethylenedibromide and orthodichlorobenzene, were transported to the Arsenal and stored temporarily. The insecticides were mixed with fuel oil and an emulsifier, and placed in containers. By December 31, 1952, the Army had shipped approximately 197,000 pounds of ethylenedibromide and 183,000 pounds of orthodichlorobenzene off the Arsenal (RMA, 1952a; Smith, 1952; RMA, 1952b; RMA, 1952c, p. 33).

³ A highly chlorinated liquid insecticide, $C_{10}H_6Cl_8$.

During the summer of 1954, the Army sprayed 750 acres of the Arsenal with isopropyl ester of 2,4-D to control the growth of Russian thistle, Salsola pertifer. Russian Thistle was a prickly weed that grew along railroads, roadways, and fields throughout the Arsenal (RMA, 1954; Shogren, 1977, p. 31).

In mid-1955, the Arsenal's maintenance division sprayed approximately 500 acres with isopropyl ester of 2,4-D to control Russian thistle and other noxious weeds. Later in the year, 200 acres were sprayed with isopropyl ester of 2,4-D, and 320 acres of land were treated with sodium fluoracetate to reduce the prairie dog population (RMA, 1955a; RMA, 1955b).

Between July and September 1956, the maintenance division chemically treated 400 acres of land to control broad-leaf weeds. Approximately 2,000 pounds of Ureabor was spread around various Arsenal buildings to control vegetation. Ureabor, a nonselective soil sterilant, was a combination of sodium borates, 3-p-chlorophenyl, and 1,1 dimethylurea. By the year's end, an additional 5,300 pounds of Ureabor had been spread in the North Plants area and other sections of the Arsenal (RMA, 1956a; RMA, 1956b; Shogren, 1977, p. 34).

Early in 1957, the maintenance division applied 10,700 pounds of Ureabor to various areas of the Arsenal for the purpose of controlling vegetation. That spring, the railroad maintenance branch spread 22,000 pounds of Ureabor along the Arsenal railroad tracks. During the same period, the insect and rodent control branch fumigated one building with hydrogen cyanide (HCN), sprayed trees and shrubbery, and spread 1,000 pounds of Ureabor Soil Sterilant for vegetation control (RMA, 1957a; RMA, 1957b). Throughout the summer and fall of 1957, the Army sprayed all trees, lawns, and shrubbery on the Arsenal to control insects and rodents.

Three acres of land were treated with Ureabor Soil Sterilant to control vegetation (RMA, 1957c; RMA, 1957d). During this period, the Army used various insecticides and rodenticides, including Warfarin,⁴ thallium sulfate, sodium fluoroacetate, Chlordane, Dieldrin, DDT, lead arsenate, Bordeaux mixture,⁵ Malathion,⁶ and nicotine sulfate (USAEHL, 1957).

In 1958, the maintenance division sprayed lawns and trees on the Arsenal to control insects, rodents, and predators. Ureabor Soil Sterilant was applied to the storage pads in Section 31 and forty-five additional acres of Arsenal land to control weed and vegetation growth (RMA, 1958a; RMA, 1958b; RMA, 1958c; RMA, 1958d).

During 1959, the Army treated the "Open Storage Area" with 2,500 pounds of Ureabor Soil Sterilant. An unknown quantity of Ureabor was applied to all active railroad trackage and areas adjacent to the Arsenal's perimeter fence (RMA, 1959a; RMA, 1959b; RMA, 1959c). Insecticides in use at this time included Chlordane, Lindane (1,2,3,4,5,6-hexachlorobenzene), Malathion, and DDT (Ledwell, 1959).

In early 1960, Army personnel spread 4,000 pounds of Ureabor Soil Sterilant around sign posts, utility poles, and warehouses. Ureabor was also placed on standby railroad trackage. During the spring, another 4,000 pounds of Ureabor were spread throughout the installation (RMA, 1960a; RMA, 1960b). On July 11, 1960, Shell's industrial hygienist contacted the Army about the possibility of having the Shell leased area sprayed for mosquitoes. Four days

⁴ A colorless crystalline compound, $C_{10}H_8O_4$, used to kill rodents

⁵ A mixture of copper sulfate, lime, and water, used as a fungicide and insecticide

⁶ Trademark for an organic compound, $C_{12}H_{19}O_2PS_2$, used as an insecticide

later, an Army representative toured Shell's leased facilities to determine which areas needed to be sprayed. By July 20, 1960, the Arsenal's insect and rodent control branch had sprayed the Shell plant area, part of Lake Ladora, and the north sides of Upper and Lower Derby Lakes (McGilvray, 1956-1972).

In the spring of 1961, the maintenance division sprayed for insects and spread 10,000 pounds of Ureabor Soil Sterilant on vegetation (RMA, 1961a). On June 30, 1961, Shell requested the Army to spray the Shell-leased area for mosquitoes under terms of a contract between Shell and the Army. Within three days, Arsenal personnel had sprayed the acetylene area and other parts of Shell's leased facilities. The picnic area north of Lake Mary possibly was sprayed in mid-July (Brisbane, 1961; McGilvray, 1956-1972; RMA, 1961b). Pesticides used by the Army in 1961 included Lindane, Chlordane, Malathion, and DDT (Vining, 1961). During the last three months of the year, the Army spread approximately 600 pounds of Ureabor Soil Sterilant around various Arsenal buildings (RMA, 1961c).

In early 1962, the maintenance division spread approximately 20,000 pounds of Ureabor Soil Sterilant around fences, sign posts, and buildings in the South Plants. Another 12,000 pounds of Ureabor were applied to active railroad trackage. The Army also treated the western end of Lake Mary with sodium arsenite to control aquatic vegetation (RMA, 1962a; RMA, 1962b). On June 22, 1962, Shell requested the Army to spray specific areas of Shell's leased facilities for mosquitoes under terms of a contract between Shell and the Army. As of July 10, 1962, Arsenal personnel had sprayed the acetylene unit, the mustard area, and the open area north of the bicycloheptadiene production unit (Brisbane, 1962; McGilvray, 1956-1972). During the summer and fall, the Army treated the eastern end of Lake Mary with sodium arsenite and

spread 20,000 pounds of Ureabor Soil Sterilant (RMA, 1962c; RMA, 1962d). The Arsenal grounds were treated with an additional 20,000 pounds of Ureabor Soil Sterilant during the first half of 1963 (RMA, 1963).

On April 2, 1962, the Army established a special projects division at the Arsenal to produce and store the biological agent TX⁷ (McNary, 1962; Whitledge, 1962). In early 1963, the special projects division initiated TX field production operations. During May and early June, approximately 650 acres of wheat were planted in fields located in Sections 23, 24, 25, and 26 (Bogan, 1963; Unauthored, 1970).

The Army used various herbicides and pesticides during each TX production season. Between May and August, 1964, the TX fields were sprayed with approximately 450 pounds of 2,4-D to control grasses and two types of weeds, broad-leaf and bindweed. One wheat field in Section 24 was treated with approximately 30 pints of Malathion to control the aphid and leaf mite population (Asai, 1964; Flucke, 1964).

During the 1965 production season, Arsenal personnel sprayed approximately 525 pounds of 2,4-D on the TX wheat fields to control grasses, bindweed, broad-leaf weeds, and knapweed. Additional quantities of 2,4,5-T (2,4,5-trichlorophenoxy acetic acid), Dowpon, and 2,4-D were sprayed on the ditches and perimeter of the production site (Clevenger, 1965). In the summer of 1966, the Army used a self-propelled sprayer to treat TX fields and 400 surrounding acres. At least 250 pounds of 2,4-D, and 500 pounds of

⁷TX was the military code name for the urediospores of Puccinia graminis var. tritici, the causal agent of wheat stem rust (RMA, 1973).

Malathion were sprayed on the TX fields that season to control weeds and insects (Krenzer and Morkovsky, 1966).

The special projects division continued to use herbicides and insecticides during the 1967 and 1968 TX production seasons. In 1968, approximately 370 pounds of 2,4-D were sprayed on 17 TX fields to control the growth of broad-leaf weeds. An additional 51 gallons of Malathion were used to control a light infestation of grasshoppers and aphids throughout the TX production site (Ammon, 1967; Young, 1967).

During the summer of 1968, the Army used chemical retardants to control the growth of vegetation in Lake Mary. The lake may have been treated twice with Diquat⁸ to control aquatic weeds. Approximately one-half to three pounds of Karmex (Diuron)⁹ were used per surface acre to control filamentous algae growth. The use of these herbicides helped release nutrients for the production of plankton, which improved fishing conditions in Lake Mary (Bartschi, 1968; Unauthored, 1968).

During the summer months of 1970, the Army sprayed insecticides throughout the Arsenal to control rodents and insects. The specific types and quantities of insecticides used that summer are unknown (Gaon, 1970a; Gaon, 1970b; Gaon, 1970c).

On December 7, 1970, the Arsenal's director of facilities requested command authorization to purchase and use approximately five gallons of R-55¹⁰ Rodent Repellent. The repellent was needed

⁸ A powerful nonpersistent herbicide, $C_{12}H_{13}Br_2N_2$, used to control water weeds.

⁹ A persistent herbicide, $C_9H_7Cl_2N_2O$, used to control annual weeds.

¹⁰ Phillips Petroleum Company's trademark name for tertiary-butylsulfenyl dimethyldithiocarbamate (Donnelly, 1970b).

to protect underground control cables which linked a network of air monitoring stations on the Arsenal's perimeter from being destroyed by gophers. On December 14, 1970, the Army gave the Arsenal permission to purchase and use the R-55 Rodent Repellent. No information was found on the actual use of this material at Rocky Mountain Arsenal (Donnelly, 1970a; Donnelly, 1970b; Grosskopf, 1970).

Between 1964 and 1969, the population of bullheads and bluegills increased significantly in Lake Mary. To eliminate an over-abundance of these warm water fish which were inhibiting the survival and growth of stocked trout, the lake was chemically treated in 1970. The water level was lowered five to six feet,¹¹ and a mixture of five gallons of 5 percent emulsifiable Rotenone and 50 pounds of 20 percent Rotenone were applied to the remaining water and sump areas on August 25, 1970. The treatment rid the lake of hordes of bluegill, a large number of black bullheads, approximately 200 rainbow trout, and a few largemouth bass. Subsequent sampling revealed a complete extermination of the undesired fish species (Donnelly, 1974; Mullan, 1975a; Mullan, 1975b; Mullan, 1975c).

Green sunfish, which were present in the canal water that was used to fill Lake Mary, entered the lake during refilling in 1970. The green sunfish population quickly matched the over-abundant populations of the undesired fish species which had existed prior to the treatment of the lake and presented similar undesirable conditions for the survival and growth of stocked fish. This

¹¹ In period documents, Lake Mary was listed as a surface lake consisting of a main body of water approximately 100 feet wide by 600 feet long; and three fingers, each about 150 feet wide by 100 feet long. The deepest portion of the lake, located at the west end, covered an area nearly 100 feet wide by 200 feet long, averaging 6.5 feet deep, with the deepest point being 9.5 feet. The depth of the remainder of the lake averaged about four feet (Donnelly, 1974; Mullan, 1975c). During 1974-1975, the lake was slightly enlarged and deepened to an average depth of 15 feet (Mullan, 1975b; Mullan, 1975c).

undesirable expansion of green sunfish densities was exacerbated by uncontrolled vegetation and weeds in the lake. To improve these conditions, the lake was drained in late August and early in September of 1974. On September 12, 1974, an unspecified amount of 5 percent emulsifiable Rotenone was applied to 38 acre-feet of mud and water in the lake. Hordes of green sunfish, a few largemouth, and approximately 200 channel catfish were killed. The lake was later refilled (Donnelly, 1974; Mullan, 1975a; Mullan, 1975b; Mullan, 1975c).

While herbicide and pesticide usage by the Army at the Arsenal continued in the 1970s and 1980s, the use of a number of herbicides and pesticides was either eliminated or sharply curtailed. Army Regulation 420-76, enacted on February 1, 1972, governed the use and handling of pesticides and defined specific responsibilities. This regulation required, inter alia, continued training and appropriate certification of personnel to prevent contamination of the environment. The regulation classified Aldrin, benzene hexachloride, Chlordane, DDT, Dieldrin, Endrin, Heptachlor, Lindane, and Toxaphene as persistent pesticides and restricted their use to essential purposes for which no reasonable substitutes existed. All pesticide spills were required to be reported. Pending establishment of federal guidelines, up to 50 gallons of obsolete or deteriorated pesticides were allowed to be destroyed by burning in a landfill which met state requirements. The reporting of all pest control operations was also required (DOA, 1971).¹² During the same year, the United States Environmental Protection Agency banned almost all uses of DDT because of its persistence and its possible health hazards to people and ill effect on wildlife (LBA, 1981).

¹²For Rocky Mountain Arsenal, meticulous record has been found only for the period 1979 through 1985. The data obtained from this record are presented in Appendix A.

In January 1973, the Army began a pesticide monitoring program at 20 different Army installations in the United States to determine the extent of pesticide occurrence in the installation environment and to evaluate the hazards created, if any (Kelly, 1973). Under this program, a number of soil and water samples were taken in 1973 and 1974 from different areas of Rocky Mountain Arsenal, including Section 25, First Creek, Lake Mary, and the sewage oxidation pond. Although complete records are not available, at least seven samples contained detectable quantities of pesticide residues and heavy metals. However, the residual levels were determined to be within expected values, consistent with residue levels resulting from "normal" pest control activities, and within permissible levels allowed by the United States Environmental Protection Agency for public water supplies. Another four samples showed residual levels of pesticides higher than those expected as a result of "normal" pest control activities. These higher levels were considered reasonable in view of pesticide-manufacturing operations at the Arsenal by lessees of the Army (Cordo, 1973; Cordo, 1974; Johnston, 1974; Larsen, 1974a; Larsen, 1974b; Larsen, 1974c; Larsen, 1974d; Larsen, 1974e). Table I in Appendix C summarizes the available data relating to the pesticide monitoring program.

By October 1975, the Army was expediting its efforts to ensure the effectiveness and efficiency of the pest management program at the Arsenal. A number of pest management program surveys were conducted in the succeeding years. The overall purpose of these surveys was to provide technical guidance and to evaluate the pest management program from a variety of perspectives, including the medical and economic aspects of pest control, requirements for pollution abatement, available resources, and the adequacy and goals of the program. The use of herbicides was also monitored

during these surveys (Hastriter and McLaurin, 1976; confer Farlow, 1984).

The initial pest management program survey was conducted between October 6 and October 9, 1975. The ensuing report of survey results noted that the areal expanse of that portion of the Arsenal where pest control services were applied totalled 17,500 acres, including 1,536,000 square feet of building space. Cockroach control in food service areas was accomplished using Baygon 1.5 Emulsifiable Insecticide applied as a 1.1 percent emulsion on a monthly basis in warehouses (Buildings 331 and 332), clubs (Buildings 151 and 383), and a dining facility (Building 166). Cockroach control in nonfood areas of these facilities was accomplished using a 47.5 percent solution of Diazinon applied as a 0.5 percent emulsion on a monthly basis. Control in all other areas of the Arsenal was handled on an as-needed basis upon request. Mosquito control consisted of the application of a solution of two ounces of 57 percent Malathion emulsifiable concentrate per gallon of water twice weekly during the breeding season. Moth control had been attempted using Baygon and Malathion. Mice control was effected by placing brown paper bags, at intervals of eight to 12 feet, containing four ounces of ready-mix bait each. Also under the control of pest control personnel, herbicide operations required only two herbicides, Bromacil-borate Mixture and 2,4-D. A vegetation space sprayer was used for 2,4-D applications, whereas a granular spreader mounted on a railroad car was used for dispensing the Bromacil along railroad right-of-ways (Hastriter and McLaurin, 1976). Table I of Appendix B lists herbicides and pesticides being stored at the Arsenal at the time of the survey.

The October 1975 survey report cited a number of deficiencies in pest control operations and practice. Bulk pesticides were

stored in an outdoor storage shed which also housed tractors, dispersal equipment, and mowing machinery. Adjacent to and part of the Building 544 herbicide- and pesticide-mixing shop, this storage shed was provided with a dirt floor enclosed on all sides. The dirt floor appeared to be saturated with pesticides. Empty pesticide containers were punched and disposed of in the sanitary landfill.¹³ Pesticides were being used without honoring labeling instructions (Hastriter and McLaurin, 1976).

In October 1975, pest control equipment on hand at the Arsenal included a two-gallon hand sprayer, a 100-gallon-capacity turbine, an insecticide applicator, a chemical dispersal unit, and a "towed-type" vegetation space sprayer. The equipment required periodic replenishments of pesticide solutions. Normally, water was added to the unused, excess, or residue solution, and the resulting diluted solution, or "rinse water," was disposed of by spraying or pouring it onto the ground at or near the application site. The possibility of environmental contamination as a result of these operations was considered minimal, since the quantity of pesticide remaining in the rinse water was less than the concentration which was originally sprayed (Hastriter and McLaurin, 1976; Mack, 1985b). No wastewater was generated during the pesticide-mixing process at the Building 544 herbicide and pesticide shop (Lynes, 1985, pp. 79-81). The 1975 survey report recommended contacting the United States Environmental Protection Agency for the approval of this and other suggested methods of disposal (Hastriter and McLaurin, 1976).

In addition, the report emphasized the need for changes that the Arsenal's pest management program in pesticide practices

¹³ The Arsenal's sanitary landfill is located in south-central Section 30, designated as Site 30-4 (Ebasco, 1987).

storage and mixing operations (Hastriter and McLaurin, 1976). Subsequent follow-up pest management program surveys were to follow the 1975 pest management program survey.

Between 1975 and 1978, the Army implemented a consolidated pesticide sampling program as part of a scheduled seven-year monitoring study of the presence of pesticides at a number of Army installations. Soil and sediment samples were collected from unspecified Army installations¹⁴ and analyzed for Chlordane and associated compounds, including Technical Chlordane, oxychlordane, cis-Chlordane, trans-Chlordane, heptachlor, heptachlor epoxide; DDT and its derivative compounds, o,p'-DDT, p,p'-DDT, o,p'-DDE, and p,p'-DDE; the cyclodiene group, including Aldrin, Dieldrin, and Endrin; the organophosphate group, including Malathion, Chlorpyrifos, Diazinon, Parathion, and Ronnel; and benzene hexachloride (BHC) and Lindane (McDermott, 1981).

This pesticide monitoring study concluded that the highest concentrations of pesticides at Army installations using pesticides normally were found in pesticide shop and storage areas, followed by sewage treatment, landfill, and residential areas. Sediment samples had the lowest concentrations of pesticides in the same context. By offering a comparison of one-time installation sampling with the interinstallation, multi-year sampling which revealed "normal" concentration levels, this study also provided a basis for the identification of potential "problem" areas. The mean transformed totals, by land use area for 1975-1978, determined by the study were as follows: sediment, less than 0.13 part per million; residential areas, between 0.25 and 0.5 part per million;

¹⁴ Rocky Mountain Arsenal may have participated in the sampling, since during the subject period at least two pesticide monitoring surveys were conducted at the Arsenal by the United States Environmental Hygiene Agency, the overseer of the four-year sampling program. The first monitoring survey took place between July 14 and 18, 1975, and the second between March 29 and April 2, 1976. The results were apparently not reported independently of the multi-year study (Johnston, 1975; Johnston, 1976a; Johnston, 1976b).

shop and storage areas, between 2.5 and 3.5 parts per million; and other selected areas, between 0.75 and 0.53 part per million (McDermott, 1981). Table II of Appendix C summarizes the "normal" pesticide and herbicide concentration levels in soil and sediment samples taken from selected Army installations where herbicides and pesticides are known to have been used for pest and vegetation control.

Between 1975 and 1978, the Army conducted a study to evaluate the distribution of pesticides in the soil and biota of the environment of Rocky Mountain Arsenal, on the basis of a comparative analysis of samples collected from the Arsenal and 33 other installations in 1975. Table III in Appendix C gives the number of pesticides, means, and concentrations for all pesticides detected in the Arsenal's substrates in the course of this study. The study indicated that under "good" pest practices, pesticide concentrations in various environmental media rarely would exceed the following levels: 5.0 parts per million (ppm) in soil, 0.1 ppm in sediment, and 1.0 ppm in fish and birds. Using these criteria, the study concluded that the Arsenal's pesticide shop and pesticide storage areas, sewage disposal plant, recreational areas, and impoundments had excessive levels of pesticide concentrations. In general, environmental contamination by pesticides appeared to be in excess of that which would be expected to result from recognized pest management practices. However, the study made no effort to identify other potential sources of pesticide contamination, i.e., pesticide production activities conducted by lessees of the Army (Olds et al., 1978). Table IV in Appendix C summarizes the pertinent findings and conclusions of the study.

In July of 1976, the Center for Disease Control of the U.S. Department of Health, Education and Welfare at Fort Collins, Colorado identified the plague bacillus (Yersina pestis) in fleas

collected from the burrows of black-tailed prairie dogs in a colony at Rocky Mountain Arsenal. Based on the increased incidence of plague in Colorado, both the Center for Disease Control and the Colorado Department of Health recommended that flea control measures be instituted immediately in prairie dog towns adjacent to areas frequented by humans at Rocky Mountain Arsenal (Phillips, 1976). As a further precautionary measure, the Army decided in August 1976 to eliminate all potentially infected prairie dogs in these areas (Johnston, 1976).

Approximately 1,000 acres of land infested with prairie dogs were identified and quarantined pending the implementation of control measures to reduce flea indices to less than 0.3 per burrow (Phillips, 1976). To achieve the necessary objective, the affected acreage in Sections 2, 3, 9, 22, 25, 26, 28, 31, 33, 35 and 36 was first dusted with approximately 2,100 pounds of flea control registered 10 percent Sevin (Carbaryl) and 1,100 pounds of non-flea control Sevin (Carbaryl) (Phillips, 1976; Fairbanks and Pelle, 1976; Johnston, 1976c; Byrne, 1976). Subsequently, an estimated 200 pounds of 2 percent zinc phosphide bait was applied at a lethal dose rate of 4 grams per burrow. The control measures implemented resulted in the elimination of approximately 6,000 prairie dogs (Johnston, 1976c; Turner, 1976).

In 1977, the Army revised the land management plan for Rocky Mountain Arsenal. Overall, the revised plan aimed to effect an updated coordination of all land use and grounds maintenance activities at the Arsenal. Subsection program provisions detailed approved methods for the control of insects and weed growth and the maintenance of shrubs and trees (Shogren, 1977).

Soil sterilants were used to keep ammunition storage magazines free from all plant growth. Additional control measures were

directed at the Russian thistle, which dominated at the edges of cultivated fields, along railroad tracks and roadways, and in unused fields. A solution of 2,4-D was used to keep this weed in check. The areas around storage tanks, security fence lines, and railroad rights of way were all treated with Ureabor, a granular, nonselective soil sterilant. Power poles and substations were treated in the same manner (Shogren, 1977). Trees, shrubs, and evergreens surrounding the administration quarters were sprayed with organic phosphates to control chewing insects. Malathion was used to control sucking insects in this area, and spraying occurred on a weekly basis, or when necessary. According to the maintenance plan, one quart of 57 percent Malathion emulsifying concentrate was mixed with 100 gallons of water and sprayed as a wet spray. A 3-percent Malathion emulsion was used for residual applications (Shogren, 1977).

In late 1977, the Army was storing approximately two tons of DDT for the Colorado Department of Health in Building 643 on the Arsenal. On April 4, 1978, the Army transferred the supply of DDT off the Arsenal to Buckley Air National Guard Base (Emerson, 1978a; Emerson, 1978b; Rodger, 1977b).

In 1979, the Army conducted an installation pest management program review at the Arsenal. The resulting report disclosed the following information. A 14-gallon metal drum containing 85 percent Naled was stored in the shed adjacent to Building 544. In addition, 10 gallons of an unidentified pesticide remained stored in a 55-gallon metal drum in the storage shed. No disposition of this substance was possible until it had been accurately identified. Four 5-gallon drums of Ded-Weed¹⁵ remained stored at the

¹⁵ Ded-Weed is a herbicide consisting of a mixture of 2,4,5,-T and 2,4-D. It was manufactured by the Thompson Hayward Chemical Company.

Arsenal, pending plans for final disposition following the Environmental Protection Agency's suspension of the use of 2,4,5-T in February 1979. Finally, the report noted that bulk quantities of pesticides were stored in Buildings 616 and 618. These buildings were the supply division warehouses, and contained in excess 500 gallons of unidentified pesticides (Grodt, 1979).

The 1979 installation pest management program report contained a discussion of pest control programs that were currently in operation. Action was being taken to control the rodent population. Anticoagulant poison was used to bait rodent feeding stations along interior walls in Building 362. This same control method was used in Building 383 (Grodt, 1979). Mosquito surveillance had begun on August 1, 1978. The old barracks area and Building 383 were targets of this investigation. Adult mosquitoes were sprayed with 3- and 5- percent concentrations of Malathion, 57 percent EC. Mosquito larvae were also treated with Malathion at a rate of approximately 13 fluid ounces per acre (Grodt, 1979).

Following the pest management program review, the Arsenal adopted a number of the recommendations contained in the report. The drum of Naled was to be repackaged for storage in accordance with the appropriate regulations. Malathion was to be applied in accordance with label directions and Environmental Protection Agency regulations. Pending the construction of a new pest control shop, pesticide rinse water was to be disposed by spraying over a large outdoor area (Mack, 1979).

Another pest management program review was conducted in early 1980. By this time, the construction of a new pest control shop replacing Building 544 had been completed in Building 742. The program review report noted the following: 1) Pesticides stored prior to disposal by the supply division in Buildings 616 and 643

for the most part contained 2,4-D and 2,4-D - 2,4,5-T; 2) The 14-gallon drum containing 85 percent Naled in need of repackaging was being stored in Building 742; and 3) 12 four-pound containers of Wilco Ground Squirrel Bait, use of which was not permitted in Colorado, were being stored in Building 643. It was hoped that the substance could be returned to the manufacturer or transferred to California, where its use was permitted (Grodt, 1980).

During 1980, a new mosquito control program was implemented at the Arsenal. This program was run jointly by Rocky Mountain Arsenal and the City of Denver, Department of Public Health. As a result of this program, adult mosquitoes in areas of vegetation were controlled with a mixture of 2-percent solution of Malathion and 0.12 percent Carbaryl. A 2-percent solution of Malathion was applied to standing water to control larval mosquito development (Grodt, 1980).

In 1981, a further pest management program review was conducted at the Arsenal. The metal drum containing Naled mentioned in the previous review was still present and was being stored in Building 643 (Grodt, 1981). The program review noted the additional problem presented by twenty-two 55-gallon drums containing DDT. These drums were stored in Building 616 pending final disposition by the Army's defense property disposal office. It was recommended that these drums be transferred to Building 643 and stored in accordance with Environmental Protection Agency regulations (Grodt, 1981). In September 1981, the defense property disposal office received all records relating to the stored DDT. On September 18, it reported that the DDT had been sold and that the defense property disposal office was awaiting Environmental Protection Agency clearance to remove the DDT from storage in Building 616 (Heim, 1981).

The mosquito control program, run jointly by the Arsenal and the City of Denver Department of Health, continued in 1981. A mixture of 2 percent Malathion and 0.12 percent Carbaryl was sprayed on vegetation to eliminate adult mosquitoes. A 2-percent solution of Malathion was applied to standing water for larval mosquito control (Grodt, 1981).

The use of herbicides and pesticides was reported by Arsenal personnel on a monthly basis in compliance with Army requirements derived from the 1972 regulation governing the use of herbicides and pesticides. Unfortunately, available records enable the reconstruction of a comprehensive record only for the period 1979 through 1985. During March 1979, Diazinon was used as a residual treatment in residential and warehouse areas to control cockroaches and spiders. Anticoagulants were used to control rodents in some industrial areas. Pyrethrum was used in some warehouse areas to control food pests, and Bromacil-borate Mixture was used in open areas with underbrush for all vegetation (Marlow, 1979a).

In April 1979, Diazinon and Bromacil-borate Mixture were used in the pest control program. Diazinon was used in residual treatments of cockroaches for 2,000 square feet of warehouse space. Bromacil-borate Mixture was used as a sterilant for vegetation on four acres of open field (Marlow, 1979b). During May, mosquitoes were treated with Malathion, and food pests were controlled with Pyrethrum. Diazinon was used in the warehouse areas for other insects (Sutherland, 1979). In June, mosquitoes in various parts of the Arsenal were treated with Carbaryl or Malathion. Bromacil-borate Mixture, Dursban, Timec, and Pyrethrum were also used during this month (Marlow, 1979c).

Carbaryl, Malathion, and Pyrethrum were used during July 1979. These substances were used to control mosquitoes and ants in open,

grassy fields and in the warehouse area (Marlow, 1979d). In August, Carbaryl was used at food handling buildings to control ants (Marlow, 1979e).

In September 1979, anticoagulants were used on mice in over 57,000 square feet of warehouse space, 230,000 square feet of industrial space, and 6,000 square feet of office areas and/or food handling areas. In addition, 610,000 cubic feet of warehouse space were treated with Pyrethrum and 9,000 square feet were treated with Diazinon (Marlow, 1979f).

In October 1979, another 610,000 cubic feet of warehouse space were treated with Pyrethrum. Diazinon was used in 11,000 square feet of warehouse space as well. Anticoagulants were spread over 33,000 square feet of office and industrial space. Finally, Bromacil-borate Mixture was used on eight acres of open, grassy fields to control all vegetation (Marlow, 1979g).

Anticoagulants were used in November and December 1979, to control mice in 27,000 square feet of industrial space and 3,000 square feet of office space. Bromacil-borate Mixture was spread over 12 acres of grassy, open field to control all vegetation (Marlow, 1979h; Marlow, 1980a).

From January through April 1980, anticoagulants to control mice were used on 90,000 square feet of warehouse space and 12,000 square feet of industrial area. Diazinon was used on 8,000 square feet of warehouse area and 1,000 square feet of food-handling space. In addition, Bromacil-borate Mixture was used to control all vegetation on an acre of open, grassy field during January, February, and March. During March 1980, 2,000 square feet of office space were treated with Carbaryl, and 610,000 cubic feet of

warehouse area were treated with Pyrethrum to control food pests (Marlow, 1980b; Marlow, 1980c; Marlow, 1980d; Marlow, 1980e).

In June 1980, anticoagulants were used to control mice in 37,000 square feet of warehouse space and 12,000 square feet of industrial area. Carbaryl was spread over 15 acres of open, grassy field to control mosquitoes and five acres of the same terrain to eliminate leaf-chewing insects. Warehouse areas totaling 4,000 square feet were sprayed with Diazinon as were 2,000 square feet of residential area. In addition, Diquat was sprayed, by hand, over eight acres of a surface impoundment to control aquatic weeds. Malathion was spread over open, grassy fields totaling 125 acres to control mosquitoes and culicoids. Finally, four acres of surface impoundment were treated for mosquitoes with Naled, and zinc phosphite was used on four acres of open, grassy field to control prairie dogs (Marlow, 1980f).

During July 1980, mice were controlled by placing anticoagulants in bait covering 18,000 square feet of warehouse space. Also, Carbaryl was used to combat leaf-chewing insects on two acres of open, grassy field, and Diazinon was used to treat 2,000 square feet of warehouse space and 2,000 square feet of residential area. Malathion was used to control culicoids on 177 acres of open, grassy field. The herbicide Borate-2,4-D was used on five acres of similar terrain (Marlow, 1980g).

In August 1980, anticoagulants again were used to combat mice in 48,000 square feet of industrial area and 3,000 square feet of office space. Herbaceous, broad-leaf weeds were controlled on three acres of open, grassy field through the use of Borate-2,4-D. Malathion was spread over thirty-five acres of the same terrain to eliminate culicoids, and Bromacil-borate Mixture was spread over one acre to control all vegetation (Sutherland, 1980).

During September 1980, Diquat was employed to control aquatic weeds in a ten-acre area of A warehouse area totaling 2,000 square feet was treated with Diazinon to eliminate food pests. Finally, 54,000 square feet of warehouse area and 45,000 square feet of industrial area were treated with anticoagulants used in bait for mice (Marlow, 1980h).

In October 1980, warehouse areas totaling 1,280,000 cubic feet were fumigated with Pyrethrum to eliminate food pests. Cockroaches were controlled with Diazinon in 2,000 square feet of both industrial and warehouse areas. Bromacil-borate Mixture was sprayed over seven acres of open, grassy field to control all vegetation. Finally, Borate-2,4-D was sprayed over 34 acres of similar terrain to eliminate herbaceous, broad-leaf weeds, and Diquat was used against aquatic weeds (Marlow, 1980i).

In November 1980, anticoagulants in mice bait were used in 102,000 square feet of industrial space, 99,000 square feet of warehouse area, and 3,000 square feet of both office and food-handling areas. In December, 45,000 square feet of industrial areas and 12,000 square feet of warehouse areas were treated. In addition, vegetation was controlled in open, grassy fields with Bromacil-borate Mixture. During each month, three acres were treated. Finally, Diazinon was used to eliminate spiders in 7,000 square feet of warehouse space (Marlow, 1980j; Marlow, 1981a).

In February 1981, anticoagulants were used on 84,000 square feet of warehouse space and 42,000 square feet of industrial area. Vegetation on one acre of open, grassy field was controlled with Bromacil-borate Mixture, and Diazinon was used to treat 9,000 square feet of warehouse space and 1,000 square feet of industrial area (Marlow, 1981b). No activity was reported during March, and there were only limited projects during April. In this month,

vegetation on eight acres of open, grassy fields was controlled with Bromacil-borate Mixture, and grassy weeds were controlled on three acres of the same terrain using DCPA (2,3,5,6-tetrachloro-terephthalic acid). Finally, 6,000 square feet of warehouse space were treated with Diazinon (Marlow, 1981c).

During May 1981, twelve acres of open, grassy terrain were treated with Carbaryl and Malathion to eliminate mosquitoes. Diazinon was used on 1,000 square feet of residential area, 8,000 square feet of warehouse area, 3,000 square feet of industrial area, and one acre of open, grassy field. Anticoagulants in mice bait were placed on 3,000 square feet of residential space, and 610,000 cubic feet of warehouse space were sprayed with Pyrethrum. Finally, Borate-2,4-D was spread over one acre of open, grassy field to control broad-leaf weeds (Marlow, 1981d).

During June 1981, anticoagulants were used again in mice bait. Warehouse areas totaling 105,000 square feet were treated in this manner. Also, Carbaryl and Malathion were used on 48 acres of open, grassy field to control leaf-chewing insects and culicoids. Diazinon was used on 2,000 square feet of office space, and warehouse space totaling 5,000 square feet. Finally, 640,000 cubic feet of office space were sprayed with Pyrethrum to control moths, and Borate-2,4-D was used to control broad-leaf weeds on seven acres of open, grassy field (Marlow, 1981e).

In July 1981, 15,000 square feet were treated for mice with anticoagulants. Carbaryl, to combat leaf-chewing insects, and Malathion, to get rid of culicoids, were spread over 36 acres of open, grassy field. The herbicide Borate-2,4-D was spread on three acres of similar terrain, and Diazinon was used on 12,000 square feet of warehouse space. Finally, Diquat was used to combat aquatic weeds on the surface impoundment, and 1,240,000 cubic feet

of warehouse area were treated with Pyrethrum to control food pests (Marlow, 1981f).

Pest control activities during August and September were similar. During these two months, mice were controlled with anticoagulants in 79,000 square feet of industrial space and 9,000 square feet of office space. Diazinon was used against ants, cockroaches, and spiders in 7,000 square feet of warehouse area, 2,000 square feet of office area, and 2,000 square feet of industrial space. Finally, in September, Pyrethrum was used on 640,000 cubic feet of warehouse space to control food pests (Marlow, 1981g; Marlow, 1981h).

During October 1981, anticoagulants were used to eliminate mice in 21,000 square feet of industrial area and 90,000 square feet of warehouse space. Calcium cyanide was spread over 25 acres of open, grassy field to control prairie dogs. Three acres of similar terrain were treated with 2,4-D to control broad-leaf weeds. Also, Carbaryl and Malathion were applied to an additional four acres to combat culicoids. Finally, Diazinon was used on warehouse space totaling 8,000 square feet and 1,000 square feet of residential area (Marlow, 1981i).

In November 1981, 120,000 square feet of industrial area and 45,000 square feet of warehouse space were treated with anticoagulants. Mice were controlled on 31,000 square feet of open, grassy field, 21,000 square feet of warehouse space, and 15,000 square feet of industrial space with the same substance in the following month. Bromacil-borate Mixture was used on four acres of open, grassy field to control all vegetation. Calcium cyanide was used on 33 acres of the same terrain to combat prairie dogs. Finally, Diazinon was used to control spiders in warehouse areas totaling 24,000 square feet (Marlow, 1981j; Marlow, 1981k).

Between January and May 1982, pest control activities were directed primarily at mice and spiders. Anticoagulants were used to control mice on 225,000 square feet of warehouse space, 51,000 square feet of industrial area, 9,000 square feet in food-handling buildings, and 30 acres of open, grassy fields. Spiders were controlled with Diazinon in 48,000 square feet of warehouse space, 2,000 square feet of food handling space, and 2,000 square feet of residential area. In addition to these projects, Bromacil-borate Mixture was spread over nine acres of open, grassy field to control all vegetation. Also, Diazinon, was used to combat ants on 2,000 square feet of both industrial and food-handling areas (Marlow, 1982a; Marlow, 1982b; Marlow, 1982c; Marlow, 1982d).

During June 1982, food pests were sprayed with Pyrethrum in a warehouse area encompassing 90,000 cubic feet. Various insects were treated with Diazinon in 19,000 square feet of warehouse space, 3,000 square feet of industrial space, and 2,000 square feet in food-handling buildings, residential areas, and office space. Malathion and Carbaryl were used on 11 acres of open, grassy fields to combat culicoids and on one acre to combat mice. Malathion was also used on 10 acres of surface impoundment against mosquitoes. Finally, calcium cyanide was used to control prairie dogs on four acres of open, grassy field (Marlow, 1982e).

During July 1982, Roundup, an uncombined herbicide, was spread over three acres and 12,000 square feet of open, grassy field to combat grassy weeds. Anticoagulants were used on 6,000 square feet of both industrial and residential areas. Two acres of open, grassy fields were treated with Malathion and Carbaryl to eliminate culicoids. One acre of similar terrain was sprayed with Bromacil-borate Mixture to control all vegetation. Also, aquatic weeds in eight acres of the surface impoundment were treated with Diquat. Finally, Pyrethrum was used on 132,000 cubic feet of warehouse

space, and Diazinon was used on 4,000 square feet of warehouse space (Marlow, 1982f).

No pest control reports have been located for August through November 1982. However, a command health report for November states that pest control activities during that month emphasized weed control, mice baiting, and spider and cockroach control through the use of Diazinon (Lewis, 1982). In December, anticoagulants were used to control mice in 9,000 square feet of industrial areas and 12,000 square feet of warehouse space. Also, Diazinon was used on 17,000 square feet of warehouse space to eliminate spiders (Marlow, 1983a).

During January 1983, 18,000 square feet of warehouse space were treated with anticoagulants, and Diazinon was used on 5,000 square feet of warehouse space to control spiders and termites (Marlow, 1983b; Smith, 1983). During the next two months, more pesticide use was reported. In February, 148,000 square feet of industrial space and 33,000 square feet of warehouse space were treated with anticoagulants. Diazinon was used on 14,000 square feet of warehouse area and 1,000 square feet in food-handling buildings. Vegetation on two acres of open, grassy fields was treated with Bromacil-borate Mixture, and zinc phosphide was used on three acres to control prairie dogs (Unauthored, 1983). During March, Diazinon was used on 3,000 square feet of warehouse space. Mice were controlled with anticoagulants spread throughout 42,000 square feet of industrial space and 3,000 square feet of warehouse area. Strychnine was also used to eradicate mice over a four-acre plot of open, grassy field (Marlow, 1983c).

In April 1983, strychnine and anticoagulants again were used to control mice. Strychnine was applied to three acres, and anticoagulants were applied to 15 acres of open, grassy fields.

Anticoagulants were also applied to 15,000 square feet of industrial space and 66,000 square feet of warehouse space. Diazinon was used to control ants within 1,000 square feet of industrial areas. Finally, five acres of land were treated with zinc phosphide to control prairie dogs, and Bromacil-borate Mixture was used to control all vegetation on one acre of open, grassy field (Marlow, 1983d).

During May 1983, two plus acres of open field were treated with Diquat to reduce grassy weeds. Herbicide 2,4-D was applied to 39 acres of similar terrain to eliminate broad-leafed weeds. Malathion and Phostoxin¹⁶ were spread on four acres of land to control culicoids and prairie dogs, respectively. Diazinon use during this period included treatment of 16,000 square feet of warehouse space and 1,000 square feet each in industrial areas and food-handling areas. Finally, Pyrethrum was used in warehouse areas, and anticoagulants were used in 3,000 square feet of industrial space to control mice (Marlow, 1983e).

In June 1983, anticoagulants were used to eliminate mice in 6,000 square feet of residential areas and 8,000 square feet of warehouse space. Diazinon was used in 15,000 square feet of warehouse space, 1,000 square feet of food-handling areas, and 14 acres of open, grassy fields. In addition, one acre of land was treated with aluminum phosphide to control prairie dogs, Bromacil-borate Mixture was used on three acres to control all vegetation, Malathion was used on seven acres, and Diquat was spread over five acres to control grassy weeds. Finally, 30 acres of similar terrain were treated with 2,4-D to eradicate broad-leaf weeds (Marlow, 1983f).

¹⁶ A rodenticide, produced by Degesch America Incorporated, Weyers Cave, Virginia, consisting of 55 percent aluminum phosphide and inert substances for the remainder (Mack, 1985a; Polchow, 1982). Approval to use Phostoxin was issued on August 8, 1983 (Marten, 1983).

During July, the Army emphasized the treatment of open grassy fields on the Arsenal. Ten acres were treated with Malathion, 24 acres were treated with Borate-2,4-D, and six acres were treated with Diquat. In addition, Carbaryl was used on 20 acres to control leaf-chewing insects, Phostoxin was used on five acres for prairie dogs, and Bromacil-borate Mixture was sprayed on two acres to control vegetation. Other pest control activities included the application of Diazinon in warehouse areas totaling 13,000 square feet. Another 63,000 square feet were treated with anticoagulants, and 230,000 cubic feet of warehouse space were treated with Pyrethrum to control food pests (Marlow, 1983g).

In August 1983, mice were eradicated by using anticoagulants in warehouse areas encompassing 33,000 square feet. Pyrethrum was used to kill cockroaches in 435,000 cubic feet of warehouse space. Diazinon was used in 11,000 square feet of warehouse space, 2,000 square feet of food handling areas, and 1,000 square feet of residential space. In addition, 11 acres of open, grassy fields were treated for leaf-chewing insects with Carbaryl, 18 acres were treated with Borate-2,4-D for broad-leaf weeds, and two acres were treated with Diquat. Finally, six acres of the same terrain were treated with Phostoxin to eliminate prairie dogs. Malathion was used on five acres (Marlow, 1983h).

During the final four months of 1983, aluminum phosphide was used to control prairie dogs on 18 acres of open, grassy field. Diazinon was used on 25,000 square feet of warehouse space, 2,000 square feet of industrial space, 1,000 square feet of food-handling areas, and 2,000 square feet of hospital or laboratory areas to eliminate cockroaches. In addition, Pyrethrum was used on 64,000 square feet of both warehouse and food-handling areas. Anticoagulants were used to control mice on 120,000 square feet of warehouse space, 54,000 square feet of industrial areas, 18,000 square feet

of food-handling areas, and 3,000 square feet of both office and hospital or laboratory areas. Finally, anticoagulants were used on 16 acres of open, grassy fields. Borate-2,4-D was used on eight acres, and Phostoxin was used on four acres of the same terrain (Marlow, 1983i; Marlow, 1983j; Marlow, 1983k; Marlow, 1984a).

In the winter and early spring of 1984, anticoagulants once again were used to control mice throughout various parts of the Arsenal. Approximately 183,000 feet of warehouse space were treated, as were 66,000 square feet of industrial areas, 15,000 square feet of food-handling areas, and 42 acres of open, grassy fields. Diazinon was used on 39,000 square feet of warehouse areas and 3,000 square feet of food-handling areas. Finally, vegetation on four acres of land was treated with the herbicide Hyvarx, and an additional two acres were treated with Bromacil-borate Mixture (Marlow, 1984b; Unauthored, 1984a; Unauthored, 1984b; Unauthored, 1984c).

During May 1984, the focus of activity was the treatment of open, grassy fields. Malathion was sprayed on 18 acres, Diazinon was applied to seven acres, and Phostoxin was used to combat prairie dogs on four acres. All vegetation on a four-acre plot was treated with Bromacil-borate Mixture. In addition, Diquat was used on six acres to control aquatic weeds, Borate - 2,4-D was used on broad-leaf weeds covering 114 acres, and 2,4-D - 2,4,5-T was used on 70 acres. Finally, Trifluralin was applied to 13 acres, 2,4-D was used on 40 acres, and the combined herbicide, Diquat - 2,4-D, was used to treat an additional 12,000 square feet of the same terrain. Other pest control activities during the month included the use of Diazinon on 3,000 square feet of warehouse space. Pyrethrum was used on 120,000 cubic feet of warehouse space and 120,000 cubic feet of food-handling area (Unauthored, 1984d).

No pest control activity was reported for June and July 1984. Control programs resumed in August. During this month, anticoagulants were used to control mice in 15,000 square feet of warehouse space. Diazinon was applied to 1,000 square feet of food-handling areas, 4,000 square feet of warehouse space, and 1,000 square feet of office space. Pyrethrum was used on 135,000 cubic feet of warehouse space. Eight acres of open, grassy fields were treated with Malathion and Carbaryl for leaf-chewing insects and culicoids. Bromacil-borate Mixture was used on five and a half acres and 2,4-D was used on 24 acres to control culicoids. Chlordane, to control ants, was applied to an additional 800,000 square feet of the same terrain, and anticoagulants were applied to 15,000 square feet (Unauthored, 1984e).

During the last four months of 1984, anticoagulants were used on 126,000 square feet of warehouse space, 15,000 square feet of office space, 84,000 square feet of industrial areas, 6,000 square feet of food-handling areas, and five acres and 30,000 square feet of open, grassy terrain. In addition, food pests were treated with Pyrethrum in 120,000 cubic feet of warehouse space. Diazinon was used on 31,000 square feet of warehouse space and 1,000 square feet of food-handling areas. Finally, Phostoxin was sprayed over three acres of open, grassy fields to control prairie dogs (Unauthored, 1984f; Unauthored, 1984g; Unauthored, 1984h; Unauthored, 1984i).

Between February 22, 1984, and February 29, 1984, the Army conducted a pest management program review to evaluate the installation management program and to provide recommendations for improving program effectiveness and correcting any attendant health and environmental problems. The program review report noted that as of the date of the program review, pesticides were being stored at three locations on Rocky Mountain Arsenal: Building 742 (pest control shop), Building 643 (supply storage), and Shed 1 of Plot

3 of the Toxic Storage Yard. The herbicides and pesticides kept in Building 743 were housed in separate rooms which were dry, secure, fire resistive, curbed, and ventilated. The pest control shop was used for mixing purposes in addition to storage. Building 643 was used to store excess pesticides and was dry, secure, and fire resistive, but not suitable for pesticide storage due to a lack of ventilation. Shed 1 of Plot 3 of the Toxic Storage Yard was used for excess inventory storage. Pesticide inventories taken during the 1984 program review may be found in Tables VIII and IX of Appendix B which follows this report (Farlow, 1984).

During the first three months of 1985, anticoagulants were used on 12,000 square feet of warehouse space, 6,000 square feet of industrial area, and 23 acres of open, grassy fields to eradicate mice. In addition, approximately 15 acres of land were treated with Phostoxin to control prairie dogs. Four acres were treated with Trifluralin to eliminate grassy and broad-leaf weeds. Finally, Diazinon was used on 12,000 square feet of warehouse area to control spiders (Unauthored, 1985a; Unauthored, 1985b; Unauthored, 1985c).

In April 1985, trifluralin was used on six acres of open, grassy fields, and Bromacil was used on 48 acres to control all vegetation. Broad-leaf weeds on 151 acres were sprayed with Dicamba and Borate-2,4-D. Bromacil-borate was used on three and a half acres for vegetation, and prairie dogs were controlled on 120 acres with Phostoxin. Finally, Diazinon was used on 4,000 square feet of warehouse space, and anticoagulants were used to control mice on 30,000 square feet of warehouse space (Unauthored, 1985d).

In May of 1985, Banvel- 2,4-D was applied to 129 open, grassy acres to control the growth of broad-leaf weeds, while five acres

were treated with Diquat to suppress the growth of mixed grassy and broad-leaf weeds. Additionally, Dalapon was used on five acres of open land for grassy weeds and Dicamba - 2,4-D was sprayed manually over 380 acres to herbaceous broad-leaf weeds. Phostoxin was also used in May of 1985 to combat the prairie dog population on 75 open, grassy acres of Rocky Mountain Arsenal (Unauthored, 1985e).

During June of 1985, Dicamba - 2,4-D was sprayed with power equipment over 233 open, grassy acres in an effort to control weeds. Phostoxin was applied to 60 acres of open, grassy land to combat prairie dogs at the Arsenal (Unauthored, 1985f).

The month of July 1985 saw continued use of Dicamba - 2,4-D for weed control over 60 open, grassy acres. Anticoagulant and Pyrethrum were used to control mice and other food pests within 40,000 square feet and 64,000 cubic feet of warehouse space, respectively. Mosquitoes were treated with Malathion over ten open, grassy acres (Unauthored, 1985g).

In August of 1985, Diazinon was sprayed in 7,000 square feet of industrial space, anticoagulants were utilized to control mice in 5,000 square feet of industrial space, and Pyrethrum was applied to 12,000 square feet of industrial space to wipe out roaches. Finally, 30 open, grassy acres at Rocky Mountain Arsenal received Phostoxin to help eliminate prairie dogs (Unauthored, 1985h).

In September of 1985, Diazinon was used for wasp and bee eradication in 1,000 square feet of warehouse space, as well as spider control over 21,000 square feet of open, grassy land. Anticoagulants were employed for mice control in 216,000 square feet of warehouse space, while Phostoxin was sprayed over 30 open, grassy acres to combat prairie dogs (Unauthored, 1985i).

During October 1985, anticoagulants were used as bait in 103,000 square feet of warehouse space to control mice. Diazinon was applied to 2,000 square feet of warehouse space for ant and spider prevention, and also to 26,000 square yards of warehouse space to handle wasps and bees (Unauthored, 1985j).

In November 1985, 63,000 square feet of warehouse area were treated with Pyrethrum to control miscellaneous food pests. In addition, Diazinon was used as a residual treatment over 2,000 square feet of warehouse space for spider control. Lastly, 247,000 square feet of warehouse space were baited with anticoagulant to eradicate mice (Unauthored, 1985k).

In January 1986, an inventory of herbicides, rodenticides, and pesticides stored in the Building 742 pest control shop was conducted. The results of the inventory can be found in Table X of Appendix B which follows this report (Marlow, 1986).

In April 1987, the administrators at Rocky Mountain Arsenal were contemplating the implementation of another prairie dog control program to begin in August or September of 1987, and an additional program providing for the spraying of mosquitoes starting in May of 1987 and continuing throughout the summer. As planned, the prairie dog control program was to focus on the following areas:

- 1) Old barracks area and fire station;
- 2) The club and swimming pool area, and the western south plants area;
- 3) The logistics area;
- 4) The rifle range, reserve center, and picnic area;

- 5) The air force building and construction area;
- 6) Three-quarters of a mile from the north and western boundaries;
- 7) Fifty feet along Seventh Avenue on both sides from Quebec to "D" Street; and
- 8) Sixty feet on both sides of "B" Street, "C" Street, and "D" Street from Seventh Avenue to the north boundary.

The mosquito control program would concentrate on the South Lakes area, Section 20 and certain other unidentified areas of the Arsenal (Demarest and Lovell, 1987; Heim, 1987).

Documents and records necessary to a reconstruction of Army pest and vegetation control operations and herbicide and pesticide usage after 1987 were not available to the authors of this study. During the periods covered by this report, the Army used numerous substances in a variety of ways to control vegetation growth, reduce the presence of insects and rodents and to control the fish and prairie dog populations at the Arsenal. In retrospect, the application of these substances appears to have fallen squarely within the parameters of normal usage during the periods covered.

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APPENDICES

TABLE OF CONTENTS

<u>Appendix</u>	<u>Page</u>
APPENDIX A	
Table I: Documented Quantities of Herbicides, Pesticides, and Insecticides Used at Rocky Mountain Arsenal	A-2
Table II: Herbicides and Pesti- cides Used at Rocky Mountain Arsenal in Unknown Quantities	A-9
Table III: Pesticides and Herbi- cides Used at Rocky Mountain Arsenal: Consolidated Data	A-12
Table IV: Aggregate Yearly Quantities of Herbicides, Pesticides, and Insecticides Used at Rocky Mountain Arsenal	A-22
APPENDIX B	
Table I: 1975 Pesticide Inventory, Building 544 Area	B-2
Table II: 1979 Pesticide Inventory Building 544 and Storage Shed	B-4
Table III: 1979 Pesticide Inventory, Building 616	B-7
Table IV: 1979 Pesticide Inventory, Building 618	B-8
Table V: 1979 Pesticide Inventory, Building 785	B-10
Table VI: 1981 Pesticide Inventory, Building 616	B-11
Table VII: 1981 Pesticide Inventory, Building 643	B-12

Table VIII: 1984 Pesticide
Inventory, Building 643

B-13

Table IX: 1984 Pesticide
Inventory, Toxic Storage
Yard

B-14

Table X: 1986 Herbicide
Rodenticide, and Pesticide
Inventory, Building 742

B-15

APPENDIX C

Table I: Results of Pesticide
Residue Analyses and Heavy
Metal Analyses of Soil,
Sediment, and Water Samples:
Rocky Mountain Arsenal
Pesticide Monitoring Program,
1973-1974

C-2

Table II: "Normal" Pesticide
and Herbicide Concentration
Levels in Soil and Sediment
Samples Taken from Selected
Army Installations Using
Pesticides and Herbicides,
1975 through 1978

C-5

Table III: Evaluation of Pesticide
Distribution in Selected Components
of the Environment of Rocky
Mountain Arsenal, 1975:
Pesticide Profile

C-6

Table IV: Evaluation of Pesticide
Distribution in Selected Components
of the Environment of Rocky
Mountain Arsenal, 1975: Overall
Concentrations of Pesticides

C-7

APPENDIX D

Documents Reviewed

D-2

APPENDIX A

TABLE I

Documented Quantities of Herbicides, Pesticides,
and Insecticides Used at Rocky Mountain Arsenal¹

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>QUANTITY</u>	<u>REFERENCES</u>
2,4-D	1964	450 pounds	(Asai, 1964; Flucke, 1964)
	1966	250 pounds	(Krenzer and Morkovsky, 1966)
	1968	370 pounds	(Ammon, 1967-1968)
	1983	4,325 gallons	(Marlow, 1983e; Marlow, 1983f)
	1984	2,950 gallons	(Unauthored, 1984d; Unauthored, 1984e)
2,4-D-2,4,5-T	1984	1,900 gallons	(Unauthored, 1984d)
Aluminum phosphide	1983	16 pounds	(Marlow, 1983f; Marlow, 1983i)
Anticoagulant	1979	91 pounds	(Marlow, 1979a; Marlow, 1979f; Marlow, 1979g; Marlow, 1979h; Marlow, 1980a)
	1980	193 pounds	(Marlow, 1980b; Marlow, 1980c; Marlow, 1980f-j; Marlow, 1981a; Sutherland, 1980)
	1981	233 pounds	(Marlow, 1981b; Marlow, 1981d; Marlow, 1981e-k)

¹The above-furnished quantities represent actual substances used at Rocky Mountain Arsenal as quantified in the historical database.

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>QUANTITY</u>	<u>REFERENCES</u>
	1982	114 pounds	(Marlow, 1982a-d; Marlow, 1982f; Marlow, 1983a)
	1983	253 pounds	(Marlow, 1983b-k)
	1984	209 pounds	(Marlow, 1984a-b; Unauthored, 1984a-h)
	1985	105 pounds	(Unauthored, 1985a-d; Unauthored, 1985g-k)
Barvel-2,4-D	1985	2,200 gallons	(Unauthored, 1985e)
Borate-2,4-D	1980	1,350 gallons	(Marlow, 1980g; Marlow, 1980i; Sutherland, 1980)
	1981	528 gallons	(Marlow, 1981d-f; Marlow, 1981i)
	1983	5,150 gallons	(Marlow, 1983g-k)
	1984	4,000 gallons	(Unauthored, 1984d)
	1985	2,300 gallons	(Unauthored, 1985d)
Bromacil	1985	854 gallons	(Unauthored, 1985d)
Bromacil-borate	1979	2,800 pounds	(Marlow, 1979a-c; Marlow, 1979g; Marlow, 1979h; Marlow, 1980a)
	1980	1,726 pounds	(Marlow, 1980b-d; Marlow, 1980i; Marlow, 1980j; Marlow, 1981a; Sutherland, 1980)
	1981	1,300 pounds	(Marlow, 1981b; Marlow, 1981c; Marlow, 1981j)
	1982	1,000 pounds	(Marlow, 1982a-d; Marlow, 1982f)

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>QUANTITY</u>	<u>REFERENCES</u>
	1983	4,900 pounds	(Unauthored, 1983; Marlow, 1983d; Marlow, 1983f; Marlow, 1983g; Marlow, 1983i; Marlow, 1983j)
	1984	424 gallons	(Unauthored, 1984c; Unauthored, 1984f; Unauthored, 1984g)
		1,850 pounds	(Unauthored, 1984d; Unauthored, 1984e)
	1985	150 pounds	(Unauthored, 1985d)
Calcium cyanide	1981	68 pounds	(Marlow, 1981i; Marlow, 1981j)
	1982	20 pounds	(Marlow, 1982e)
Carbaryl	1976	3,200 pounds	(RMA, 1976)
	1979	3,940 gallons	(Marlow, 1979c-e)
	1980	352 gallons	(Marlow, 1980d-g)
	1981	2,500 gallons	(Marlow, 1981d-f; Marlow, 1981i)
	1982	450 gallons	(Marlow, 1982e; Marlow, 1982f)
	1983	2,450 gallons	(Marlow, 1983g; Marlow, 1983h)
	1984	200 gallons	(Unauthored, 1984e)
Chlordane	1984	11 gallons	(Unauthored, 1984e)
Copper sulfate	1943	300 pounds	(CWS, 1945)
DCPA	1981	80 pounds	(Marlow, 1981c)
Dalapon	1985	100 gallons	(Unauthored, 1985e)

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>QUANTITY</u>	<u>REFERENCES</u>
Diazinon	1979	35 gallons	(Marlow, 1979a; Marlow, 1979b; Marlow, 1979f; Marlow, 1979g; RMA, 1952c; Sutherland, 1979)
	1980	34 gallons	(Marlow, 1980b-j)
	1981	105 gallons	(Marlow, 1981b-d; Marlow, 1981f-k)
	1982	105 gallons	(Marlow, 1982a-f; Marlow, 1983a)
	1983	1,468 gallons	(Marlow, 1983b-k; Marlow, 1984a)
	1984	783 gallons	(Marlow, 1984b; Unauthored, 1984a; Unauthored, 1984c-f; Unauthored, 1984h)
Dicamba	1985	45 gallons	(Unauthored, 1985a-d; Unauthored, 1985h-k)
	1985	2,300 gallons	(Unauthored, 1985d)
	1985	10,200 gallons	(Unauthored, 1985e-g)
	1980	120 gallons	(Marlow, 1980f; Marlow, 1980h; Marlow, 1980i)
	1981	35 gallons	(Marlow, 1981f)
	1982	750 gallons	(Marlow, 1982f)
	1983	1,418 gallons	(Marlow, 1983e-g)
	1984	600 gallons	(Unauthored, 1984d)
	1985	100 gallons	(Unauthored, 1985e)
	1979	250 pounds	(Marlow, 1979c)
Hyvarx	1984	630 gallons	(Unauthored, 1984c)
Malathion	1964	30 pints	(Asai, 1964; Flucke, 1964)

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>QUANTITY</u>	<u>REFERENCES</u>
	1966	500 pounds	(Krenzer and Morkovsky, 1966)
	1979	3,940 gallons	(Marlow, 1979c; Marlow, 1979d; Sutherland, 1979)
	1980	4,700 gallons	(Marlow, 1980f; Marlow, 1980g; Sutherland, 1980)
	1981	2,500 gallons	(Marlow, 1981d-f; Marlow, 1981i)
	1982	925 gallons	(Marlow, 1982e; Marlow, 1982f)
	1983	2,300 gallons	(Marlow, 1983e-g)
	1984	2,250 gallons	(Unauthored, 1984d; Unauthored, 1984e;
	1985	350 gallons	(Unauthored, 1985g)
Maled	1980	200 gallons	(Marlow, 1980f)
Phostoxin	1983	35 pounds	(Marlow, 1983e; Marlow, 1983g; Marlow, 1983j)
	1984	28 pounds	(Unauthored, 1984d; Unauthored, 1984e; Unauthored, 1984g)
	1985	831 pounds	(Unauthored, 1985a-f; Unauthored, 1985n-k)
Pyrethrum	1979	6 gallons	(Marlow, 1979a; Marlow, 1979c; Marlow, 1979d; Marlow, 1979f; Marlow, 1979g; RMA, 1982c; Sutherland, 1979)
	1980	2 gallons	(Marlow, 1980b-e; Marlow, 1980i)
	1981	4 gallons	(Marlow, 1981d-f; Marlow, 1981h)
	1982	2 gallons	(Marlow, 1982e; Marlow, 1982f)

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>QUANTITY</u>	<u>REFERENCES</u>
	1983	10 gallons	(Marlow, 1983e; Marlow, 1983f-k)
	1984	4 gallons	(Marlow, 1983i; Marlow, 1983k; Unauthored, 1984d-f)
	1985	3 gallons	(Unauthored, 1985g; Unauthored, 1985h; Unauthored, 1985k)
Rotenone	1970	50 pounds	(Mullan, 1975c)
Roundup	1982	287 gallons	(Marlow, 1982f)
Strychnine	1983	35 pounds	(Marlow, 1983c; Marlow, 1983d)
Timec	1979	4 gallons	(Marlow, 1979c)
Trifluralin	1984	1,100 pounds	(Unauthored, 1984d)
	1985	460 pounds	(Unauthored, 1985d)
Ureabor	1956	7,300 pounds	(RMA, 1956a; RMA, 1956b)
	1957	33,700 pounds	(RMA, 1957a; RMA, 1957b)
	1960	8,000 pounds	(RMA, 1960a; RMA, 1960b)
	1961	10,000 pounds	(RMA, 1961)
	1962	72,000 pounds	(RMA, 1962a; RMA, 1962c)
	1976	200 pounds	(Johnston, 1976; Phillips, 1976)
Zinc phosphide	1980	7 pounds	(Marlow, 1980f)
	1983	50 pounds	(Marlow, 1983d; Unauthored, 1983)

TABLE II

Herbicides and Pesticides Used at Rocky Mountain Arsenal
in Unknown Quantities

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>REFERENCES</u>
2,4-D	1950	(Chemical Corps, 1950)
	1954	(RMA, 1:54; Shogren, 1977, p. 31)
	1965	(Clevenger, 1965)
2,4,5-T	1965	(Clevenger, 1965)
Bordeaux mixture	1957	(USAEHL, 1957)
Chlordane	1950	(Chemical Corps, 1950)
	1957	(USAEHL, 1957)
	1959	(Ledwell, 1959)
	1961	(Vining, 1961)
Crystalline copper sulfate (Blue Vitriol)	1944	(CWS, 1945)
	1945	(CWS, 1945)
DDT	1945	(Mnookin <u>et al.</u> , 1945)
	1946	(McLaughlin <u>et al.</u> , 1946)
	1948	(Harbaugh, 1948)
	1957	(USAEHL, 1957)
	1959	(Ledwell, 1959)
	1961	(Vining, 1961)
	1950s and 1960s	(Mitchell, 1986)
Dieldrin	1957	(USAEHL, 1957)

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>REFERENCES</u>
Dowpon	1965	(Clevenger, 1965)
Hydrogen cyanide	1957	(RMA, 1957a-b)
Isopropyl ester of 2,4-D	1955	(RMA, 1955a; RMA, 1955b)
Karmex (Diuron)	1968	(Bartschi, 1968; Unauthored, 1968)
Lead arsenate	1957	(USAEHL, 1957)
Lindane	1959	(Ledwell, 1959)
	1961	(Vining, 1961)
Malathion	1957	(USAEHL, 1957)
	1959	(Ledwell, 1959)
	1961	(Vining, 1961)
	1978	(Grodt, 1979)
Nicotine sulfate	1957	(USAEHL, 1957)
"Oil"	1944	(Shaw <u>et al.</u> , 1944)
	1947	(McLaughlin, 1947)
Organic phosphates	1977	(Shogren, 1977)
Paris Green	1944	(Shaw <u>et al.</u> , 1944)
"Rat poison"	1944	(Holaday <u>et al.</u> , 1944)
Potenone	1974	(Donnelly, 1974; Mullan, 1975a-c)
Sodium arsenite	1962	(RMA, 1962a-b)
Sodium fluoracetate	1955	(RMA, 1955a-b)
	1957	(USAEHL, 1957)
Thallium sulfate	1957	(USAEHL, 1957)
Ureabor	1958	(RMA, 1958a-d)
	1959	(RMA, 1959a-c)
Warfarin	1957	(USAEHL, 1957)

TABLE III

**Pesticides and Herbicides Used at
Rocky Mountain Arsenal: Consolidated Data¹**

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>REFERENCES</u>
2,4-D	1950	(Chemical Corps, 1950)
	1954	(RMA, 1954; Shogren, 1977, p. 31)
	1964	(Asai, 1964; Flucke, 1964)
	1965	(Clevenger, 1965)
	1966	(Krenzer and Morkovsky, 1966)
	1968	(Ammon, 1967-1968)
	1983	(Marlow, 1983e; Marlow, 1983f)
	1984	(Unauthored, 1984d; Unauthored, 1984e)
2,4-D - 2,4,5-T	1984	(Unauthored, 1984d)
2,4,5-T	1965	(Clevenger, 1965)
Aluminum phosphide	1983	(Marlow, 1983f; Marlow, 1983i)
Anticoagulant	1979	(Marlow, 1979a; Marlow, 1979f; Marlow, 1979g; Marlow, 1979h; Marlow, 1980a)
	1980	(Marlow, 1980b; Marlow, 1980c; Marlow, 1980f-j; Marlow, 1981a; Sutherland, 1980)

¹This table lists all pesticides and herbicides identified in Tables I and II of Appendix A.

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>REFERENCES</u>
	1981	(Marlow, 1981b; Marlow, 1981d; Marlow, 1981e-k)
	1982	(Marlow, 1982a-d; Marlow, 1982f; Marlow, 1983a)
	1983	(Marlow, 1983b-k)
	1984	(Marlow, 1984a-b; Unauthored, 1984a-h)
	1985	(Unauthored, 1985a-d; Unauthored, 1985g-k)
Banvel-2,4-D	1985	(Unauthored, 1985e)
Borate-2,4-D	1980	(Marlow, 1980g; Marlow, 1980i; Sutherland, 1980)
	1981	(Marlow, 1981d-f; Marlow, 1981i)
	1983	(Marlow, 1983g-k)
	1984	(Unauthored, 1984d)
	1985	(Unauthored, 1985d)
Bordeaux mixture	1957	(USAEHL, 1957)
Bromacil	1985	(Unauthored, 1985d)
Bromacil-borate	1979	(Marlow, 1979a-c; Marlow, 1979g; Marlow, 1979h; Marlow, 1980a)
	1980	(Marlow, 1980b-d; Marlow, 1980i; Marlow, 1980j; Marlow, 1981a; Sutherland, 1980)
	1981	(Marlow, 1981b; Marlow, 1981c; Marlow, 1981j)
	1982	(Marlow, 1982a-d; Marlow, 1982j)

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>REFERENCES</u>
	1983	(Unauthored, 1983; Marlow, 1983d; Marlow, 1983f; Marlow, 1983g; Marlow, 1983i; Marlow, 1983k)
	1984	(Unauthored, 1984c; Unauthored, 1984f; Unauthored, 1984g) (Unauthored, 1984d; Unauthored, 1984e)
	1985	(Unauthored, 1985d)
Calcium cyanide	1981	(Marlow, 1981i; Marlow, 1981j)
	1982	(Marlow, 1982e)
Carbaryl	1976	(RMA, 1976)
	1979	(Marlow, 1979c-e)
	1980	(Marlow, 1980d-g)
	1981	(Marlow, 1981d-f; Marlow, 1981i)
	1982	(Marlow, 1982e; Marlow, 1982f)
	1983	(Marlow, 1983g; Marlow, 1983h)
	1984	(Unauthored, 1984e)
Chlordane	1950	(Chemical Corps, 1950)
	1957	(USAEHL, 1957)
	1959	(Ledwell, 1959)
	1961	(Vining, 1961)
	1984	(Unauthored, 1984e)
Copper sulfate	1943	(CWS, 1945)

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>REFERENCES</u>
Crystalline copper sulfate (Blue Vitriol)	1944	(CWS, 1945)
	1945	(CWS, 1945)
DCPA	1981	(Marlow, 1981c)
DDT	1945	(Mnookin <u>et al.</u> , 1945)
	1946	(McLaughlin <u>et al.</u> , 1946)
	1948	(Harbaugh, 1948)
	1957	(USAEHL, 1957)
	1959	(Ledwell, 1959)
	1961	(Vining, 1961)
	1950s and 1960s	(Mitchell, 1986)
Dalapon	1985	(Unauthored, 1985e)
Diazinon	1979	(Marlow, 1979a; Marlow, 1979b; Marlow, 1979f; Marlow, 1979g; RMA, 1952c; Sutherland, 1979)
	1980	(Marlow, 1980b-j)
	1981	(Marlow, 1981b-d; Marlow, 1981f-k)
	1982	(Marlow, 1982a-g)
	1983	(Marlow, 1983b-k; Marlow, 1984a)
	1984	(Marlow, 1984b; Unauthored, 1984a; Unauthored, 1984c-f; Unauthored, 1984h)
	1985	(Unauthored, 1985a-d; Unauthored, 1985h-k)
Dicamba	1985	(Unauthored, 1985d)
Dicamba-2,4-D	1985	(Unauthored, 1985e-g)
Dieldrin	1957	(USAEHL, 1957)

SUBSTANCEYEARREFERENCES

Diquat-2,4-D

1980

(Marlow, 1980f;
Marlow, 1980h;
Marlow, 1980i)

1981

(Marlow, 1981f)

1982

(Marlow, 1982f)

1983

(Marlow, 1983e-g)

1984

(Unauthored, 1984d)

1985

(Unauthored, 1985e)

Dowpon

1965

(Clevenger, 1965)

Dursban

1979

(Marlow, 1979c)

Hydrogen cyanide

1957

(RMA, 1957a-b)

Hyvarx

1984

(Unauthored, 1984c)

Isopropyl ester of
2,4-D

1955

(RMA, 1955a; RMA, 1955b)

Karmex (Diuron)

1968

(Bartschi, 1968;
Unauthored, 1968)

Lead arsenate

1957

(USAEHL, 1957)

Lindane

1959

(Ledwell, 1959)

1961

(Vining, 1961)

Malathion

1957

(USAEHL, 1957)

1959

(Ledwell, 1959)

1961

(Vining, 1961)

1964

(Asai, 1964;
Flucke, 1964)

1966

(Krenzer and
Morkovsky, 1966)

1977

(Shogren, 1977)

1978

(Grodt, 1978)

1979

(Marlow, 1979c;
Marlow, 1979d;
Sutherland, 1979)

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>REFERENCES</u>
	1980	(Marlow, 1980f; Marlow, 1980g; Sutherland, 1980)
	1981	(Marlow, 1981d-f; Marlow, 1981i)
	1982	(Marlow, 1982e; Marlow, 1982f)
	1983	(Marlow, 1983d-f)
	1984	(Unauthored, 1984d; Unauthored, 1984e)
	1985	(Unauthored, 1985g)
Naled	1980	(Marlow, 1980f)
Nicotine sulfate	1957	(USAEHL, 1957)
"Oil"	1944	(Shaw <u>et al.</u> , 1944)
	1947	(McLaughlin, 1947)
Organic phosphates	1977	(Shogren, 1977)
Paris Green	1944	(Shaw <u>et al.</u> , 1944)
Phostoxin	1983	(Marlow, 1983e; Marlow, 1983g; Marlow, 1983k)
	1984	(Unauthored, 1984d; Unauthored, 1984e; Unauthored, 1984g)
	1985	(Unauthored, 1985a-f; Unauthored, 1985h-k)
Pyrethrum	1979	(Marlow, 1979a; Marlow, 1979c; Marlow, 1979d; Marlow, 1979f; Marlow, 1979g; RMA, 1952c; Sutherland, 1979)
	1980	(Marlow, 1980b-e; Marlow, 1980i)
	1981	(Marlow, 1981d-f; Marlow, 1981h)

<u>SUBSTANCE</u>	<u>YEAR</u>	<u>REFERENCES</u>
	1982	(Marlow, 1982e; Marlow, 1982f)
	1983	(Marlow, 1983d; Marlow, 1983f-k)
	1984	(Marlow, 1983i; Marlow, 1983k; Unauthored, 1984d-f)
	1985	(Unauthored, 1985g; Unauthored, 1985h; Unauthored, 1985k)
"Rat poison"	1944	(Holaday <u>et al.</u> , 1944)
Rotenone	1970	(Mullan, 1975c;
	1974	(Donnelly, 1974; Mullan, 1975a-c)
Roundup	1982	(Marlow, 1982f)
Sodium arsenite	1962	(RMA, 1962a-b)
Sodium fluoracetate	1955	(RMA, 1955a-b)
	1957	(USAEHL, 1957)
Strychnine	1983	(Marlow, 1983c; Marlow, 1983d)
Thallium sulfate	1957	(USAEHL, 1957)
Timec	1979	(Marlow, 1979c)
Trifluralin	1984	(Unauthored, 1984d)
	1985	(Unauthored, 1985d)
Ureabor	1956	(RMA, 1956a; RMA, 1956b)
	1957	(RMA, 1957a; RMA, 1957b)
	1958	(RMA, 1958a-d)
	1959	(RMA, 1959a-c)
	1960	(RMA, 1960a; RMA, 1960b)
	1961	(RMA, 1961)

SUBSTANCEYEARREFERENCES

	1962	(RMA, 1962a; RMA, 1962c)
Warfarin	1957	(USAEHL, 1957)
	1976	(Johnston, 1976; Phillips, 1976)
Zinc phosphide	1980	(Marlow, 1980f)
	1983	(Marlow, 1983d; Unauthored, 1983)

TABLE IV

Aggregate Yearly Quantities of Herbicides,
Pesticides, and Insecticides Used at
Rocky Mountain Arsenal¹

<u>Year</u>	<u>Gallons²</u>	<u>Pounds²</u>
1943		300
1944-1955		No amounts reported
1956		7,300
1957		33,700
1958		No amounts reported
1959		2,500
1960		8,000
1961		10,000
1962		52,000
1963		20,000
1964	3	450
1965		525
1966		750
1967		No amounts reported
1968		370
1969		No amounts reported
1970		50
1971-1975		No amounts reported
1976		3,200
1977-1978		No amounts reported
1979	7,925	3,141

¹Source: Appendix A, Table 1.

²The above-furnished quantities represent actual substances used at Rocky Mountain Arsenal as quantified in the historical database. The quantities reported in pounds (gallons) are independent of those reported in gallons (pounds).

<u>Year</u>	<u>Gallons²</u>	<u>Pounds²</u>
1980	6,758	1,926
1981	5,672	1,681
1982	2,519	1,134
1983	17,121	5,289
1984	13,764	3,187
1985	18,452	1,546
1986-		No amounts reported
 TOTAL	 <u>72,214</u>	 <u>157,000</u>

APPENDIX B

TABLE I
1975 Pesticide Inventory, Building 544 Area¹

<u>PESTICIDE</u>	<u>QUANTITY²</u>
2,4-D	272 gallons
2,4,5-T	25 gallons
2,4-D and 2,4,5-T	209 gallons
Anticoagulant Dusting Powder	5 pounds
Baygon Propoxur	5 pounds
Borate-Bromacil Mixture	597 pounds
Bordeaux Mixture	52 pounds
Boric Acid	10 pounds
Calcium Cyanide	5 pounds
Carbaryl	100 pounds
Chlordane	9 gallons
Copper acetoarsenite	5 pounds
DDT Powder	50 pounds
Diazinon	229 gallons
Dieldrin granules	2 pounds
Diquat	17 gallons
Diuron	5 gallons
Diuron	50 pounds
Lidnane	10 gallons
Malathion	124 gallons
Naled	22 gallons
Poison Grain	25 pounds
Propoxur	1 gallon
Pyrethrum Roach Powder	5 pounds
Simazine	20 pounds
Sodium 2,2-dichloropropionate	30 pounds
Strychnine Grain	38 pounds
Thiram	2 pounds
Vapona	140 strips
Warfarin	128 pounds

¹Source: Hastriter and McLaurin, 1976

²Quantities shown in the above chart reflect actual amounts stored but do not necessarily represent pure quantities of that substance. Many named substances were substantially diluted with water or some other chemical prior to application.

TABLE II

1979 Pesticide Inventory, Building 544 and Storage Shed¹

<u>PESTICIDE</u>	<u>AMOUNT²</u>	<u>LOCATION</u>
797-A Powdered Insecticide, pyrethrine 1 percent, silica gel 40 percent	84 ounces	Building 544
Aldrin	110 gallons	Outside Storage Shed
Arasan ^R 75 thiram 75 percent	2 pounds	Building 544
Arsenate of Lead	2 pounds	Building 544
Baygon ^R Roach Bait propoxur 2 percent	2.5 pounds	Building 544
Cyanogas-A ^R Calcium Cyanide 42 percent	1 pound	Building 544
De-Pester ^R Ded-Weed ^P 2,4-D 2,4,5-T	55 gallons	Outside Storage Shed
Diquat Water Weed Killer diquat dibromide 35.3 percent	20 gallons	Outside Storage Shed
Experimental Anticoagulant Dusting Powder calcium salt of 2-substituted 1,3 indandione 2.174 percent	4.5 gallons	Building 544
Herbicide Dimethyl Tetrachloroterephthalate Dachthal ^R W-75 DCPA 75 percent	108 pounds	Building 544

¹Source: Grodt, 1979²Quantities shown in the above chart reflect actual amounts stored but do not necessarily represent pure quantities of that substance. Many named substances were substantially diluted with water or some other chemical prior to application.

PESTICIDEAMOUNTLOCATION

Herbicide 2,4-D Thompson Weedicide Concentrate, dimethyl salt 2,4-D acid 50 percent equivalent 2,4-D acid 41.5 percent	55 gallons	Outside Storage Shed
House Mouse, Meadow Mouse, and Pocket Gopher Bait Strychnine alkaloid 0.5 percent	40 pounds	Building 544
Insecticide Chlordane EC, 73.6 percent	2 gallons	Outside Storage Shed
Insecticide Diazinon EC, 47.5 percent	5.5 gallons	Building 544
Insecticide Diazinon EC, 48.2 percent, D-Tox 4E	1 gallon	Building 544
Insecticide Diazinon Liquid Residual, 0.5 percent	2 gallons	Building 544
Insecticide Naled, 85 percent	14 gallons	Outside Storage Shed
Insecticide Powder Roach sodium fluoride 47.5 percent pyrethrins 0.2 percent	5 pounds	Building 544
Insecticide Pyrethrin, 0.6 percent	324 ounces	Building 544
Insecticide Strip dichlorovos	140 strips	Outside Storage Shed
Malathion, 57 percent	190 gallons	Outside Storage Shed
Paris Green, Copper aceto arsenite 85.4 percent	5 pounds	Building 544
Radapon ^R dalapon 82 percent	5 pounds	Building 544
Rid-A-Bird ^R endrin 9.75 percent	1 pint	Building 544
Rodenticidal Bait Anticoagulant warfarin 0.025 percent	150 pounds	Building 544
Sevin ^R Sprayable Carbaryl 80 percent	220 pounds	Building 544
Simazine 80W, 80 percent	17 pounds	Building 544

PESTICIDEAMOUNTLOCATIONULD^R BP-300 Insecticide

10.5 gallons

Building 544

Unknown

10 gallons

Outside Storage
ShedZinc Phosphide on Steam
Rolled Oats, 2 percent

250 pounds

Outside Storage
Shed

TABLE III
1979 Pesticide Inventory, Building 616¹

<u>Pesticide</u>	<u>Amount²</u> <u>Container</u>
Insecticide, DDT, 20 percent	990 gallons (55- gallon drums)
Insecticide, DDT, 20 percent	220 gallons (55-gallon drums)

¹Source:

Grodt, 1979

²Quantities shown in the above chart reflect actual amounts stored but do not necessarily represent pure quantities of that substance. Many named substances were substantially diluted with water or some other chemical prior to application.

TABLE IV
1979 Pesticide Inventory, Building 618¹

<u>Pesticide</u>	<u>Amount²</u> <u>(Container)</u>
Bordeaux Mixture copper 12.75 percent	48 pounds (4-pound bags)
Boric Acid	10 pounds (1-pound bottles)
Caw Caw Rope (bird repellent)	240 feet (48-foot bundles)
DED-Weed ^R 2,4-D 2,4,5-T	165 gallons (55-gallon drums)
Dowpon ^R dalapon 85 percent	25 pounds (5-pound boxes)
Herbicide 2,4-D, 50 percent	165 gallons (55-gallon drums)
Insecticide, Diazinon 2 percent Dust	225 gallons (25-gallon drums)
Insecticide, Lindane 1-pound/gallon	10 gallons (5-gallon cans)
Insecticide, Naled Concentrate	25 gallons (25-gallon drums)
Poison Grain strychnine 0.5 percent	50 gallons (50-gallon drums)
Tordon ^R 101 Mixture picloram 39 percent	5 gallons (5-gallon cans)
Wilco Ground Squirrel Bait chlorophacinone 0.5 percent	48 pounds (4-pound cans)

¹Source: Grodt, 1979

²Quantities shown in the above chart reflect actual amounts stored but do not necessarily represent pure quantities of that substance. Many named substances were substantially diluted with water or some other chemical prior to application.

TABLE V
1979 Pesticide Inventory, Building 785¹

<u>Pesticide</u>	<u>Amount²</u> <u>(Container)</u>
Oxy ^R Borocil IV sodium metaborate tetrahydrate 94 percent bromacil 4 percent	5,200 pounds (50-pound bags)

¹Source: Grodt, 1979

²Quantities shown in the above chart reflect actual amounts stored but do not necessarily represent pure quantities of that substance. Many named substances were substantially diluted with water or some other chemical prior to application.

TABLE VI
1981 Pesticide Inventory, Building 616¹

<u>Pesticide</u>	<u>Amount²</u> <u>(Container)</u>
Insecticide, DDT, 20 percent	990 gallons (55-gallon drums)
Insecticide, DDT, 20 percent	220 gallons (55-gallon drums)

¹Source: Grodt, 1981

²Quantities shown in the above chart reflect actual amounts stored but do not necessarily represent pure quantities of that substance. Many named substances were substantially diluted with water or some other chemical prior to application.

TABLE VII
1981 Pesticide Inventory, Building 643¹

<u>Pesticide</u>	<u>Amount²</u> <u>(Container)</u>
Bordeaux Mixture copper 12.75 percent	48 pounds (4-pound bags)
DED-Weed 2,4-D 2,4,5-T	165 gallons (55-gallon drums)
Herbicide 2,4-D, 50 percent	165 gallons (55-gallon drums)
Insecticide, aldrin (unserviceable)	110 gallons (55-gallon drums)
Insecticide, Diazinon 2 percent Dust	225 gallons (25-gallon drums)
Insecticide, Naled Concentrate	25 gallons (25-gallon drum)
Tordon 101 Mixture picloram 39 percent	5 gallons (5-gallon can)

¹Source: Grodt, 1981

²Quantities shown in the above chart reflect actual amounts stored but do not necessarily represent pure quantities of that substance. Many named substances were substantially diluted with water or some other chemical prior to application.

TABLE VIII
1984 Pesticide Inventory, Building 643¹

<u>Pesticide</u>	<u>Amount²</u> <u>(Container)</u>
Bordeaux Mixture copper 12.7 percent	48 pounds (4-pound bags)
DED-Weed 2,4-D 2,4,5-T	166 gallons (55-gallon drums)
Herbicide 2,4-D, 50 percent	100 gallons (55-gallon drums)
Insecticide, Aldrin (unserviceable)	110 gallons (55-gallon drums)
Insecticide, Diazinon 2 percent Dust	225 pounds (25-gallon drums)
Insecticide, Maled Concentrate	25 gallons (25-gallon drums)

¹Source: Farlow, 1984

²Quantities shown in the above chart reflect actual amounts stored but do not necessarily represent pure quantities of that substance. Many named substances were substantially diluted with water or some other chemical prior to application.

TABLE IX
1984 Pesticide Inventory, Toxic Storage Yard¹

<u>Pesticide</u>	<u>Amount²</u> <u>(Container)</u>
Insecticide, Heptachlor	165 gallons (55-gallon drums)

¹Source: Farlow, 1984

²Quantities shown in the above chart reflect actual amounts stored but do not necessarily represent pure quantities of that substance. Many named substances were substantially diluted with water or some other chemical prior to application.

TABLE I
1986 Herbicide, Rodenticide, and
Pesticide Inventory, Building 742¹

<u>Herbicide</u>	<u>Quantity²</u>
2,4-d 50 percent	3 Bags/5 poundseach
Banvel 48.2 percent	30 Each/1-gallon cans
Borocil Soil Sterilant	1 Bag/50 pounds
Dacthal W-75 WWP	4 Bags/24 pounds each
Diquat	17 Each/5-gallon cans
Embark Plant Growth Regulator, 28 percent	8 Each/1-gallon cans
Fertilome Lawn Fertilizer	48 Each/10-pound bags
LWK No. 2 Weed Killer	1 Quart bottle
Ortho X-77 Spreader	29 Each/1-gallon cans
Simazine 80W WWP	3 Bags/5-pounds each
Tordon 101 Mixture	1 Each/5-gallon can
 <u>Rodenticide</u>	
Anticoagulant 0.3 percent	299 Each/1-pound cans
Baygon Roach Bait 0.2 percent	1/4 Pound
Fumitoxin 55 percent	48 Flasks/2-pounds
	3.28 ounces each
Phostoxin 55 percent	120 Flasks/3.3-pounds each
Zinc Phosphide	4 Bags/50-pounds each
 <u>Pesticide</u>	
797-A-Powder Insecticide (Pyrethrin) 1.0 percent	8 Bulbs/30 ounces each
Diazinon 0.5 percent solution	1-1/4 Gallon
Diazinon 4e 47.5 percent	14 Gallons
Diazinon Concentrate 47.5 percent E.C.	12 Gallons
Dibrom 14 (Naled)	Approximately 2 Gallons
Insect Repellant (Personal Application)	17 Each dispenser/2 ounces each
Malathion 57 percent	1 Each/55-gallon drum
Naled 85 percent	3-Gallon jar
Paris Green 85.4 percent	1 Each/5 pound can
Pyrethrum Roach Powder .2 percent	
Sevin Carbaryl WWP 80 percent	15 Bags/10 pounds each
ULD 20 Smoke Odor Counteract	1 Gallon
ULD BP 300 3.0 percent Solution	1-1/4 Gallon
ULD CS 85 Micro Generator Cleaning Solvent	1 Gallon

¹Source: Marlow, 1986

²Quantities shown in the above chart reflect actual amounts stored but do not necessarily represent pure quantities of that substance. Many named substances were substantially diluted with water or some other chemical prior to application.

APPENDIX C

TABLE I

Results of Pesticide Residue Analyses and Heavy Metal Analyses of Soil, Sediment, and Water Samples: Rocky Mountain Arsenal Pesticide Monitoring Program, 1973-1974

<u>Type of Sample</u>	<u>Place of Collection</u>	<u>Results Name Concentration</u>	<u>Date Result(s) Reported</u>	<u>Reference</u>
Water	First Creek, near "E" Street	Dieldrin Trace	December 21, 1973	(Cordo, 1973)
Water	Unknown	Dieldrin 0.011 parts per million (ppm)	December 21, 1973	(Cordo, 1973)
		Endrin 0.0021 ppm		
Water	First Creek on "F" Street, between Eighth and Ninth Avenues	Mercury 0.0004 parts per million (ppm)	April 8, 1974	(Larsen, 1974a)
Water	Unknown	Mercury Detectable	April 8, 1974	(Larsen, 1974a)
Water	Sewage oxidation pond	Aldrin and Dieldrin "higher than expected values"	April 15, 1974	(Larsen, 1974b)

Soil	Between "I" and "G" Streets, near Eighth Avenue	Negative for any pesticide residues	April 15, 1974	(Larsen, 1974b)
Water	Sewage oxidation pond	Mercury 0.0002 ppm Lead 0.008 ppm	April 23, 1974	(Cordo, 1974)
Sediment	Sewage oxidation pond	p,p-DDD 0.15 ppm Aldrin <u>circa</u> 1.94 ppm ^{1,2} Chlordane Trace Dieldrin <u>circa</u> 0.19 ppm ²	April 23, 1974	(Cordo, 1974)
Water	Unknown	Aldrin "Higher than expected values"	May 15, 1974	(Larsen, 1974c)
Water	Sewage oxidation pond	Arsenic Detectable	May 22, 1974	(Larsen, 1974d)
Soil	Section 25	Unknown Detectable	August 22, 1974	(Larsen, 1974e)
Water	Lake Mary	Cadmium 0.009 ppm	December 19, 1974	(Johnston, 1974)

¹The concentration level was considered to be higher than expected from routine pest control activities.

²The second digit of the figure is not clearly legible in the documents.

TABLE II

"Normal" Pesticide and Herbicide Concentration Levels in Soil and Sediment Samples Taken from Selected Army Installations Using Pesticides and Herbicides, 1975 Through 1978¹

<u>Compound/ Category</u>	<u>Area(s) Represented</u>	<u>Yearly Mean Concentrations 1975 - 1978 (parts per million)²</u>
Chlordane	Sediment	Less than 0.06
	Residential	Between 0.1 and 0.4
	Pesticide shop and storage	Between 2.3 and 3.3
	Other selected areas	Between 0.25 and 0.5
Total DDT including DDD and DDE	Sediment	Between 0.06 and 0.25
	Residential	Between 0.50 and 0.75
	Pesticide shop and storage	About 2.0
	Other selected areas	About 1.0
Cyclodienes like Aldrin, Dieldrin, and Endrin	Sediment	Less than 0.06
	Residential	Between 0.2 and 0.4
	Pesticide shop and storage	Between 2.2 and 3.3
	Other selected areas	Between 0.2 and 0.5
Organophosphates like Malathion, Chlorpyrifor, Diazinon, Parathion, and Ronnel	Sediment	0.0
	Residential	0.0
	Pesticide shop and storage	Between 0.5 and 1.5
	Other selected areas	Less than 0.05
"BHC" including Lindane	Sediment	0.0
	Residential	0.0
	Pesticide shop and storage	Less than 0.21
	Other selected areas	Less than 0.051

¹Source: McDermott, 1981

²No units are specified in the pages reporting these data. A review of the remainder of the document and of other relevant documents indicates that all concentrations are in parts per million.

TABLE III

Evaluation of Pesticide Distribution in
Selected Components of the Environment
of Rocky Mountain Arsenal, 1975: Pesticide Profile¹

<u>Substrate</u>	<u>Number of Samples</u>	<u>Number of Pesticides</u>	<u>Concentration Range (parts per million)</u>	<u>Mean</u>
Soil	18	14	BDL ² -294.33	18.99
Sediment	7	4	BDL ² -0.13	0.05
Fish	4	8	0.12-3.53	1.57

¹Source: Olds et al., 1978

²Below detection limits--no pesticides were detected at the levels of detectability.

Table IV

Evaluation of Pesticide Distribution in
Selected Components of the Environment
of Rocky Mountain Arsenal, 1975: Overall
Concentrations of Pesticides¹

Environmental Concentration(s) Component	Not		Major Pesticide(s): Reported (parts per million)
	Excessive ²	Excessive	
Soil Pesticide Shop		X	Aldrin 34.400 Chlordane 131.83 DDT group ³ 93.53 Dieldrin 33.240
Pesticide Storage		X	Aldrin 0.55 Dieldrin 4.44
Landfill	X		
Residential	X		
Cantonment	X		

¹Source: Olds et al., 1978

²The following levels were considered excessive: soil above 5.0 ppm, sediment above 0.1 ppm, and fish above 1.0 ppm.

³This group includes DDT, DDE, and DDD.

Environmental
Component

Not
Excessive²

Excessive

Major Pesticide(s):
Reported Concentration(s)
(parts per million)

Recreation		X	DDT group ³ 11.69
Sediment Stream/originating		X	Chlordane 0.13
Impounded water	X		
Fish Impounded		X	Dieldrin 1.120

APPENDIX D

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APPENDIX D
CHEMISTRY DATA

ESR	SPECIES	TISSUE	SEX	AGE	SAMPLE	STATION ID	SITE DESCRIPTION	ARSENIC	MERCURY	ALDRIN	DDE/DPM	DDT	COMMENTS
619	And dis	liver	MALE	ADULT	8/10/12	UPPER RBT	RMA	BDL	1.71	BDL	0.781	BDL	1984 - 1985 USFWS SAMPLES
621	And dis	liver	MALE	ADULT	8/10/12	UPPER RBT	RMA	BDL	1.64	BDL	0.181	BDL	1984 - 1985 USFWS SAMPLES
627	And dis	liver	MALE	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.171	BDL	0.252	BDL	1984 - 1985 USFWS SAMPLES
628	And dis	muscle	MALE	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.154	BDL	0.164	BDL	1984 - 1985 USFWS SAMPLES
630	And dis	muscle	MALE	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.159	BDL	0.127	BDL	1984 - 1985 USFWS SAMPLES
626	And dis	muscle	MALE	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.219	BDL	0.09	BDL	1984 - 1985 USFWS SAMPLES
101	And p18	car cross	F	JUV	8/10/12	12/14	RMA	BDL	0.166	BDL	0.527	BDL	1984 - 1985 USFWS SAMPLES
111	And p18	car cross	M	JUV	8/10/12	SPRINGS	SECT. 11	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
112	And p18	car cross	M	JUV	8/10/12	SPRINGS	SECT. 11	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
124	And p18	car cross	M	ADULT	8/10/12	SPRINGS	SECT. 11	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
125	And p18	car cross	M	ADULT	8/10/12	SPRINGS	SECT. 11	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
126	And p18	car cross	M	ADULT	8/10/12	SPRINGS	SECT. 11	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
161	And p18	car cross	M	JUV	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
162	And p18	car cross	M	JUV	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
163	And p18	car cross	M	JUV	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
164	And p18	car cross	M	JUV	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
165	And p18	car cross	M	JUV	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
166	And p18	car cross	M	JUV	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
211	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
215	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
219	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
222	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
224	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
229	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
231	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
232	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
233	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
234	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
235	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
236	And p18	car cross	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
52	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
53	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
54	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
55	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
56	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
57	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
58	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
59	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
60	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
61	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
62	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
63	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
77	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
80	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
435	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
437	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES
438	And p18	eq3	M	ADULT	8/10/12	UPPER RBT	RMA	BDL	0.161	BDL	0.065	BDL	1984 - 1985 USFWS SAMPLES

2 DAYS OLD ON YOLA SAC

FROM EST 446
FROM EST 446

SE#	SPECIES	TISSUE	SEX	AGE	SAMPLE#	STATION ID	SITE DESCRIPTION	ARSENIC	MERCURY	CHEMICAL CONCENTRATIONS (UG/G)				DOC	DOT	COMMENTS
										ALUMINUM	DILUENT	ENDPOINT				
184	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.08	0.14	0.08	0.66	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
185	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
186	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
187	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
188	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
189	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
190	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
191	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
192	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
193	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
194	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
195	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
196	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
197	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
198	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
199	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
200	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
201	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
202	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
203	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
204	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
205	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
206	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
207	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
208	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
209	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
210	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
211	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
212	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
213	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
214	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
215	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
216	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
217	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
218	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
219	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
220	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
221	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
222	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
223	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
224	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
225	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
226	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
227	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
228	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
229	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
230	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
231	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
232	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
233	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
234	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
235	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
236	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
237	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
238	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
239	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
240	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
241	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
242	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
243	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
244	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
245	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
246	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
247	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
248	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
249	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
250	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
251	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
252	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
253	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
254	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
255	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
256	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
257	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
258	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
259	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71	0.156	0.156	0.156	1984 - 1985 USFWS SAMPLES	
260	Bluegill	muscle	male	ADULT	861017	LA 1234	LA 1234	0.14	0.14	0.14	0.71					

SE#	SPECIES	TISSUE	SEX	AGE	SAMPLE#	STATION ID	SITE DESCRIPTION	ANALYTIC	LAB	ALDRIN	DDE	DDT	CONCENTRATIONS (PPB)	COMMENTS
405	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
406	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
407	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
408	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
409	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
410	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
411	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
412	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
413	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
414	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
415	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
416	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
417	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
418	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
419	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
420	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
421	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
422	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
423	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
424	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
425	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
426	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
427	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
428	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
429	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
430	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
431	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
432	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
433	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
434	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
435	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
436	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
437	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
438	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
439	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
440	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
441	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
442	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
443	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
444	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
445	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
446	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
447	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
448	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
449	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
450	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
451	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
452	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
453	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
454	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
455	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
456	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
457	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
458	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
459	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
460	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
461	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
462	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
463	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
464	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
465	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
466	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
467	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
468	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
469	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
470	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
471	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
472	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
473	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
474	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
475	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
476	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
477	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
478	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
479	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
480	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
481	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
482	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
483	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
484	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
485	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
486	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
487	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
488	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
489	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
490	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
491	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
492	Con. sp.	Plant			010212	010212	010212	010212	010212	0.001	0.001	0.001	0.001	0.001
493	Con. sp.	Plant			0									

ESR	SPECIES	TISSUE	SEX	AGE	SAMPLE DATE	STATION ID	SITE DESCRIPTION	ARSENIC	MERCURY	ALDRIN	DIELDRIN	ENDRIN	DOE	DOT	COMMENTS
541	Cyn lud	kidneys	M	ADULT	8/70/12	164E	RMA	BOL	BOL	BOL	BOL	BOL	NRQ	NRQ	FROM ESE 410
542	Cyn lud	kidneys	F	ADULT	8/70/12	164E	RMA	BOL	0.188	BOL	BOL	BOL	NRQ	NRQ	FROM ESE 411
543	Cyn lud	kidneys	M	ADULT	8/70/12	164E	RMA	BOL	0.156	BOL	0.421	BOL	NRQ	NRQ	FROM ESE 412
544	Cyn lud	kidneys	M	ADULT	8/70/12	164E	RMA	BOL	0.245	BOL	BOL	BOL	NRQ	NRQ	FROM ESE 413
545	Cyn lud	kidneys	F	ADULT	8/70/12	164E	RMA	BOL	BOL	BOL	1.54	BOL	NRQ	NRQ	FROM ESE 414
546	Car thorac	mus			8/10/20	BI DG 315	SEC. 1.5 OF BI DG 315	NRQ	BOL	NRQ	NRQ	NRQ	NRQ	NRQ	
357	Car thorac	mus			8/11/05	BI DG 115	SEC. 1.5 OF BI DG 115	BOL	22.35	BOL	1.93	BOL	BOL	BOL	
358	Car thorac	mus			8/11/05	SE	ME 1/4 OF SE SEC. 5	1.3	BOL	BOL	BOL	BOL	BOL	BOL	
359	Car thorac	mus			8/11/05	SE	ME 1/4 OF SE SEC. 5	1.36	BOL	0.245	NRQ	NRQ	BOL	BOL	
360	Car thorac	mus			8/11/05	SE	ME 1/4 OF SE SEC. 5	1.53	BOL	0.216	BOL	0.914	BOL	BOL	
547	Car thorac	mus			8/11/10	BI DG 115	S. OF BARRI LANE	BOL	BOL	BOL	BOL	BOL	BOL	BOL	
548	Car thorac	mus			8/11/10	SE	ME 1/4 OF SE SEC. 5	0.997	BOL	BOL	BOL	BOL	BOL	BOL	
549	Car thorac	mus			8/11/10	SE	ME 1/4 OF SE SEC. 5	0.846	BOL	BOL	BOL	BOL	BOL	BOL	
550	Car thorac	mus			8/11/10	SE	ME 1/4 OF SE SEC. 5	0.846	BOL	BOL	BOL	BOL	BOL	BOL	
551	Car thorac	mus			8/11/10	SE	ME 1/4 OF SE SEC. 5	0.846	BOL	BOL	BOL	BOL	BOL	BOL	
552	Car thorac	mus			8/11/10	SE	ME 1/4 OF SE SEC. 5	0.846	BOL	BOL	BOL	BOL	BOL	BOL	
553	Car thorac	mus			8/11/10	SE	ME 1/4 OF SE SEC. 5	0.846	BOL	BOL	BOL	BOL	BOL	BOL	
554	Car thorac	mus			8/11/10	SE	ME 1/4 OF SE SEC. 5	0.846	BOL	BOL	BOL	BOL	BOL	BOL	
555	Car thorac	mus			8/11/10	SE	ME 1/4 OF SE SEC. 5	0.846	BOL	BOL	BOL	BOL	BOL	BOL	
556	Car thorac	mus			8/11/10	BI DG 115	BARRI LANE	BOL	BOL	NRQ	NRQ	NRQ	NRQ	NRQ	
557	Car thorac	mus			8/11/10	SE	ME 1/4 OF SE SEC. 5	0.722	BOL	BOL	BOL	BOL	BOL	BOL	
81	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	ASSIGNED ESE 8 ON 2/23/88
82	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	ASSIGNED ESE 8 ON 2/23/88
83	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
84	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
85	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
86	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
87	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
88	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
89	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
90	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
91	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
92	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
93	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
94	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
95	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
96	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
97	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
98	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
99	Fal sp	car cross	M	JUV	8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
1	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	FOUND DECOMPOSING IN BOX, SEX 184
2	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	FOUND DECOMPOSING IN BOX, SEX 184
3	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
4	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
5	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
6	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
7	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
8	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
9	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
10	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
11	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	
12	Fal sp	egg			8/10/70	184	1 AR CO. BIRDS CHAD 84	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	

Appendix D. Analysis of Ana Biotin Samples for Major Contaminants of Concern (Page 5 of 81).

SITE#	SPECIES	TISSUE	SEX	AGE	STATION ID	SITE DESCRIPTION	CHEMICAL CONCENTRATIONS (UG/G)										DOE	DOT	COMMENTS
							ARSENIC	MERCURY	ALDRIN	DITRIN	ENDRIN								
14	Fat Sp	ES3			840520 744	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
15	Fat Sp	ES3			840520 SSI	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
16	Fat Sp	ES3			840520 SSM	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
17	Fat Sp	ES3			840520 654	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
18	Fat Sp	ES3			840520 2451	RHA SEED, TRE PLANT	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
19	Fat Sp	ES3			840520 684	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
20	Fat Sp	ES3			840520 1744	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
21	Fat Sp	ES3			840521 3551	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
22	Fat Sp	ES3			840521 2751	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
23	Fat Sp	ES3			840521 3054	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
24	Fat Sp	ES3			840521 1744	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
25	Fat Sp	ES3			840522 810104	GARY MILLER FT. CRI	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
26	Fat Sp	ES3			840522 810104	RICHMOND R. MAP DRANE	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
27	Fat Sp	ES3			840522 810104	11 (CHILLING) NOV C 1	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
28	Fat Sp	ES3			840603 840104	BIGOR 1041 BOP 65	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
29	Fat Sp	ES3			840603 2744	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
30	Fat Sp	ES3			840612 840104	NO. OF HOT SHIP SPRCS	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
31	Fat Sp	ES3			840619 4875	PURPOSE R. BOP 75	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
118	Fat Sp	ES3			840629 2754	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
119	Fat Sp	ES3			840619 810104	RICHMOND R. MAP DRANE	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
120	Fat Sp	ES3			840629 2751	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
121	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
122	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
123	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
124	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
125	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
126	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
127	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
128	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
129	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
130	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
131	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
132	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
133	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
134	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
135	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
136	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
137	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
138	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
139	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
140	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
141	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
142	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
143	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
605	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
606	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
607	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
608	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
609	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
610	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
611	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
612	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
613	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
614	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
615	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
616	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
617	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
618	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
619	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
620	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
621	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
622	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
623	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
624	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
625	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
626	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
627	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
628	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
629	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		
630	Fat Sp	ES3			840629 944	RHA	NRQ	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL	BOL		

SE#	SPECIES	TISSUE	SEX	AGE	SAMPLE#	STATION ID	SITE DESCRIPTION	ARSENIC	MERCURY	ALDRIN	DIELDRIN	ENDRIN	DDT	COMMENTS
622	FUL WAT	MUSCLE	MA	ADULT	850912	UPPER RY	RMA	BOL	0.339	BOL	0.587	BOL	0.146	1984 - 1985 USFMS SAMPLES
624	FUL WAT	MUSCLE	MA	ADULT	850912	UPPER RY	RMA	BOL	0.275	BOL	0.376	BOL	BOL	1984 - 1985 USFMS SAMPLES
418	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	6.6	0.108	BOL	0.422	BOL	BOL	
419	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	0.987	BOL	BOL	0.271	BOL	BOL	
421	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	0.905	BOL	BOL	0.365	BOL	BOL	
427	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	4.2	0.072	BOL	0.446	BOL	BOL	
428	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
429	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	0.163	1.19	0.145	BOL	
430	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	0.153	1.23	0.283	BOL	
431	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	7.2	1.65	BOL	
432	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	0.046	0.496	BOL	BOL	
433	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
434	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
435	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
436	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
437	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
438	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
439	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
440	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
441	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
442	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
443	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
444	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
445	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
446	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
447	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
448	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
449	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
450	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
451	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
452	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
453	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
454	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
455	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
456	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
457	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
458	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
459	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
460	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
461	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
462	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
463	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
464	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
465	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
466	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
467	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
468	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
469	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
470	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
471	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
472	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
473	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
474	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
475	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
476	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
477	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
478	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
479	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
480	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
481	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
482	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
483	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
484	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
485	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
486	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
487	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
488	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
489	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
490	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
491	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
492	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
493	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
494	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
495	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
496	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
497	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
498	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
499	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
500	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
501	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
502	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
503	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
504	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
505	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
506	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
507	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
508	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
509	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
510	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
511	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
512	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
513	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
514	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
515	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
516	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
517	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
518	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
519	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
520	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
521	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
522	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
523	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
524	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
525	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
526	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
527	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
528	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
529	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
530	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
531	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
532	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
533	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
534	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
535	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
536	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
537	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
538	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL	BOL	
539	CRASSIDORS		MA	ADULT	850912	BASIN A	RMA	BOL	BOL	BOL	BOL	BOL</		

Appendix D. Analysis of RMA Biota Samples for Major Contaminants of Concern (Page 7 of 8).

USE#	SPECIES	TISSUE	SEX	AGE	SAMPLING STATION ID	SITE DESCRIPTION	CHEMICAL CONCENTRATIONS (UG/G)					DOY	COMMENTS
							ARSENIC	MERCURY	ALDRIN	DIELDRIN	ENDRIN		
154	OWB BIRD	MUSCLE	M	ADULT	861010 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	FROM 1 SE 190
159	OWB BIRD	MUSCLE	M	ADULT	861016 146	RMA	BOL	BOL	BOL	BOL	BOL	1890	FROM 1 SE 195
344	OWB BIRD	MUSCLE	M	ADULT	861016 315H	RMA	BOL	BOL	BOL	BOL	BOL	1890	
347	OWB BIRD	MUSCLE	M	ADULT	861016 315H	RMA	BOL	BOL	BOL	BOL	BOL	1890	
348	OWB BIRD	MUSCLE	M	ADULT	861015 WELLING	LAKESTAT. WILD. AREA	BOL	BOL	BOL	BOL	BOL	1890	
434	OWB BIRD	MUSCLE	M	ADULT	861016 315H	RMA	BOL	BOL	BOL	BOL	BOL	1890	
435	OWB BIRD	MUSCLE	M	ADULT	861017 146	RMA	BOL	BOL	BOL	BOL	BOL	1890	
437	OWB BIRD	MUSCLE	M	ADULT	861017 315H	RMA	BOL	BOL	BOL	BOL	BOL	1890	
440	OWB BIRD	MUSCLE	M	ADULT	861018 151	RMA	BOL	BOL	BOL	BOL	BOL	1890	
471	OWB BIRD	MUSCLE	M	ADULT	861015 251	RMA	BOL	BOL	BOL	BOL	BOL	1890	
473	OWB BIRD	MUSCLE	M	ADULT	861015 146	RMA	BOL	BOL	BOL	BOL	BOL	1890	
551	OWB BIRD	MUSCLE	M	ADULT	861010 107	SIC 1 AT 0 AND 71H	BOL	BOL	BOL	BOL	BOL	1890	
554	OWB BIRD	MUSCLE	M	ADULT	861016 265H	RMA	BOL	BOL	BOL	BOL	BOL	1890	
555	OWB BIRD	MUSCLE	M	ADULT	861016 315H	RMA	BOL	BOL	BOL	BOL	BOL	1890	
102	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
103	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
104	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
105	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
106	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
107	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
108	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
109	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
110	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
111	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
112	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
113	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
114	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
115	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
116	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
117	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
201	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
204	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
207	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
210	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
225	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
228	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
236	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
249	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
255	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
260	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
310	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
313	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
316	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
319	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
32	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
33	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
34	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	
35	OWB BIRD	MUSCLE	M	ADULT	861012 265	RMA	BOL	BOL	BOL	BOL	BOL	1890	

